Journal of the Kansas Entomological Society

Vol. 23 July, 1950 Number 3

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Entered as second-class matter June 7, 1939 at the Post Office at Manhattan, Kansas, under the Act of August 24, 1912.

JOURNAL OF THE KANSAS ENTOMOLOGICAL SOCIETY

A quarterly journal published in January, April, July, and October devoted to Entomology in the Western Mississippi Basin and the proceedings of the Kansas Entomological Society.

Manuscripts for publication may be sent to any of the publication committee.

The Kansas Entomological Society does not make exchanges since the Society does not maintain a library.

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Canadian or foreign subscriptions,	**2.25 per year**	**75 cents**

KANSAS ENTOMOLOGICAL SOCIETY

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Vol. 23, No. 3, July, 1950

This issue mailed June 30, 1950

Kansas Entomological Society
Vol. 23 July, 1950 Number 3

THAUMATOPSIS PECTINIFER (Zell.) INJURIOUS TO CORN IN NEBRASKA[1]

MARTIN H. MUMA and ROSCOE E. HILL
University of Nebraska, Lincoln.

Thaumatopsis pectinifer (Zell.), a sod webworm, was noted damaging corn in northeast Nebraska in late June, 1947. As the usual measures failed to give control, laboratory and field investigations of the identification, biology, distribution and control of this insect were undertaken during 1948 and 1949.

Description

Adult moths are typical crambids varying from one-half to three-fourths of an inch in length. They are yellowish brown in color with the forewings characteristically marked with a broad white sub-marginal stripe that breaks into a series of fine stripes on the apical third of the wing. Basally, the striping is edged with dark brown. Males are slightly smaller than females and darker in color.

The eggs are about 0.40 mm. long, barrel-shaped and sculptured with 12 or more distinct longitudinal ridges between which are a series of indistinct transverse ridges. Immediately after oviposition, the eggs are white to light yellow in color but soon darken to a deep flesh-pink or orange. First instar larvae have reddish-brown heads and prothoracic shields and are marked on each pale abdominal segment with five dorsal lighter reddish-brown spots that are indistinctly connected to form a transverse band. In later instars, the dorsal spots coalesce to form distinct bands on all except the last three segments of the abdomen. The prothorax and mesothorax are also banded. These characteristic markings suggest the common name, "banded webworm." Mature larvae are robust, colored white to flesh-pink with dark bands and may attain a length of three-fourths to one inch.

Pupae are light yellowish-brown to brown on all parts except the abdomen which retains the late larval coloration and banding. Few pupae were seen; those observed were about one-half inch in length.

Biology

Adult moths emerge from mid-August until early September. The adult life span was quite short, apparently lasting not more than five or six days. Mating and egg laying took place shortly after emergence. Field collected females deposited from 3 to 37 eggs. Eggs hatched in 5 to 8 days at room temperatures. Partly grown larvae over-wintered, completed their growth by late July or early August and pupated. The exact number of larval instars is not known but five or six are indicated by observation. Pupae completed development in 8 to 10 days under room temperatures.

[1] The assistance of several specialists, H. W. Capps, B. D. Burks and O. L. Cartwright, of the United States National Museum, for identifying this insect and its predators and parasites is gratefully acknowledged.

Adult moths moved in short erratic flights close to the ground. The moths displayed slight positive phototropism. A collection of 58 specimens taken at a gasoline lantern gave a ratio of 7 males to 1 female.

This insect deposited its eggs singly, scattering them indiscriminately while in flight. Caged females showed no preference for growing corn, sand, paper or glass for egg deposition.

Studies of larval instars and development were complicated in the field because of mixed instar populations, diseases, parasites and predators and in the laboratory because the larvae consumed their exuviae and fungi caused high larval mortality. First instar larvae refused germinating corn as food. Second instar larvae were collected from soil immediately surrounding Bush's sedge, **Cyperus bushii** Britton,[2] and Schwinitz's sedge, **Cyperus schweinitzii** Torr. Except for the inference drawn from their association with these native sedges nothing is known of the food of the early instars. Half grown to mature larvae have been collected from corn and sand paspalum, **Paspalum stramineum** Nash., as well as the native sedges. Larvae beyond the second instar usually feed just below the soil surface from within silken tubes similar to those of other sod-webworms. Under circumstances where cultivation and/or replanting of corn have disturbed the larvae, they have been observed feeding outside of the cases but still below the surface of the soil. In the late summer larvae feeding on corn frequently have their cases surrounded by small adobe-like clods. These clods apparently are formed by a cementing of the sand with plant juices flowing from the feeding wounds.

Larval feeding injury to corn is more apparent on young plants up to 12 inches in height. Three types of injury are exhibited. The most common form is a transverse series of holes and slots in the leaves similar to those caused by billbugs. This injury apparently is the result of larvae eating into the growing tip before the plant emerges from the soil. Another frequently seen evidence of the banded webworm is a general yellowing and wilting of the plants often accompanied by a twisted, malformed growing tip. A third and least common type of injury is a complete cutting off of the plants by the larvae. Infested plants normally support only one larva per plant but the occurrence of two larvae per plant is also common. In only one instance were three larvae found on a single plant.

In the laboratory an extremely high larval mortality resulted from the presence of two or more types of fungi. Affected larvae ceased feeding, turned yellow, then brown and died. Soon after death the larvae were covered with yellow, green or blue fungus fruiting bodies. A bacteriologist is studying preserved material but the fungi have not as yet been identified. Diseased larvae have also been collected in the field. Predation of larvae in the field reached its peak in late July and early August when adult and larval carabids of the genera **Nothopus** Lec., **Harpalus** Lat., and **Amara**

[2] Plants were determined by Dr. L. C. Newell of the Department of Agronomy, University of Nebraska.

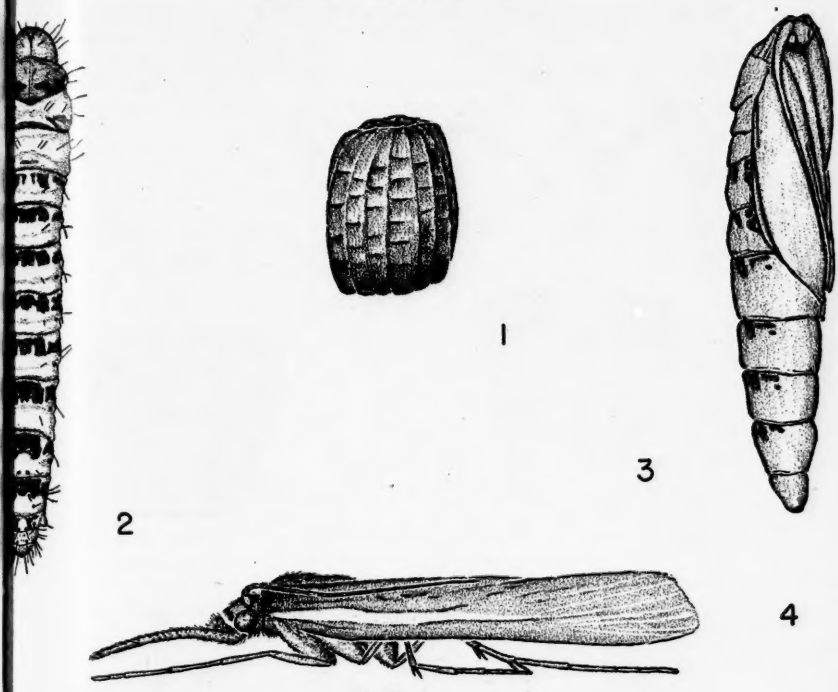


PLATE I

Figure 1. Egg. 2. Late instar larva. 3. Pupa. 4. Adult female moth of **Thaumatopsis pectinifer** (Zell.)

Bon., were frequently found associated with empty webs of the webworms. One specimen of an ichneumonid parasite, **Zaleptopygus egregiacolor** (Vier.), was reared from a larva of the webworm on August 12, 1948.

Distribution

Infestations were found to be somewhat restricted to marginal areas of the fields. In some cases, however, small fields suffered general injury. When an infestation was marginal severity of damage dropped gradually toward the center of the field. Pastures or untilled rye stubble fields maintaining stands of native sedges were nearly always adjacent to moderate or heavily infested fields. The banded webworm seems to be confined to sandy areas. An examination of 30 fields on four basic sandy soil types showed that the banded webworm was restricted to sand soils. The mean infestations based on counts of 100 to 400 corn plants on the several soils

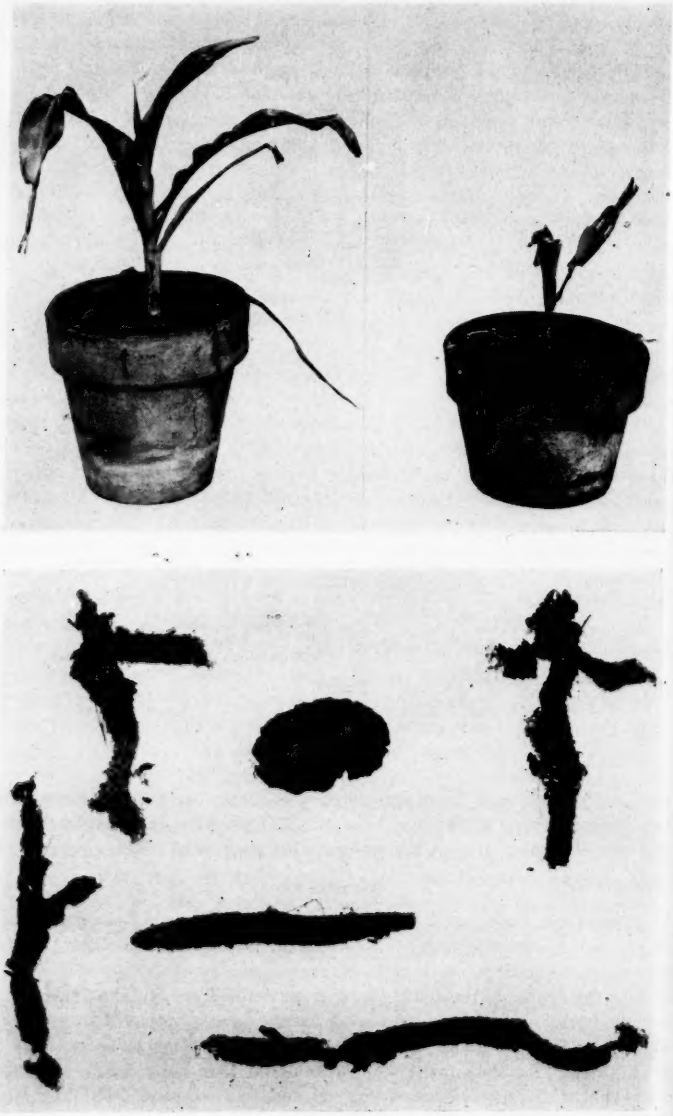


PLATE II
Typical corn injury and larval webs of **Thaumatopsis pectinifer** (Zell.)

were as follows: One field on blow sand had 21.5 percent of plants injured; 13 fields on Valentine sand, 17.4 percent; eight fields on loamy sand, 5.4 percent and only 0.6 percent of the plants were infested on sandy loam fields. This confinement of webworms to sand soils seemed to be governed somewhat by the proximity of native plant hosts.

The webworm is widely distributed on sandy soils in northeastern Nebraska, at present it is known to occur in 12 counties.

Control

Parasites, predators and disease give excellent natural control apparently reducing populations as much as 50 to 90 percent by late July and early August. This is evidenced by the large number of empty webs found 3 to 4 weeks prior to the emergence of adults.

Although no experiments have been conducted to develop cultural control practices, data accumulated in this study indicate certain possibilities. Avoidance of sandy soils for growing corn is an obvious control measure. In areas where this is not possible control may be obtained by not planting corn in fields that were in native grass or grain stubble fields that contained native sedges the previous season. Fields with poor stands frequently sustained severe webworm injury, however, on replanting and the consequent development of good stands, the damage was greatly reduced and often hardly perceptible.

An experiment was designed to test the efficiency of soil applications of certain DDT, toxaphene, chlordane and benzene hexachloride formulations against webworm larvae. All treatments were applied as sprays, some prior to planting, others at the time of first cultivation. DDT was used at 5 lbs. per acre, toxaphene and chlordane at one pound and benzene hexachloride at one pound of the gamma isomer. No significant decrease in injury was obtained with any of the chemicals at the dosages used.

Summary

Thaumatopsis pectinifer (Zell.), a crambid for which the common name "banded webworm" is suggested, is injurious to corn in northeastern Nebraska. Adults are identified by a wide white submarginal stripe on the light brown forewing. Larvae are white to flesh colored with wide reddish-brown dorsal bands on the first eight abdominal segments. Adults appear in August, eggs laid in August and September hatch, and partly grown larvae pass the winter in the soil around sedges. The species is largely confined to sandy soil were marginal damage in the corn field may be severe. Parasites and predators are particularly effective in reducing larval populations. Avoidance of fields previously containing native hosts offers the best control. Soil applications of DDT, toxaphene, chlordane and benzene hexachloride were ineffective against the insect.

NEW SPECIES OF POMPILINUS (HYMENOPTERA, POMPILIDAE)

HOWARD E. EVANS
Kansas State College, Manhattan

The subgenus **Pompilinus** of the genus **Anoplius** has long been a stumbling block to students of the Pompilid wasps. The close similarity of the species led early authors to recognize no more than two or three species, but recent authors have discovered that there are in reality a rather large number of species in the group, as evidenced chiefly by the characters of the male genitalia. In a recent paper, Dreisbach (1949, Ent. Americana, 29: 1-58) recognizes twenty species, and presents a key for separation of the males. Much work yet remains to be done, however, before this subgenus is fully understood. At the present time I wish to describe three new species of **Pompilinus;** in the future I hope to present a comprehensive review of the group as part of a revisionary study of the North American Pompilini.

Anoplius (Pompilinus) grandiflexionis n. sp.[1]
(Figs 1, 2)

Male: Length 11.5 mm.; fore wing 8.5 mm. Black, the posterior margin of the pronotum with a buff-colored stripe, interrupted medially. Clypeus, lower front, temples, and greater part of the thorax and propodeum with a fine silvery pubescence; pubescence of the dorsal parts of the head and thorax, and of the entire abdomen, dark bluish-refulgent. Front with considerable erect, black hair; abdominal sternites four and five clothed with a mat of very short, suberect setulae. Wings hyaline, the outer margins broadly and conspicuously infuscated.

Clypeus 2.2 times as broad as high, its apical margin truncate. Front at the middle .60 times the maximum breadth of the head; inner orbits diverging very slightly above. Ocelli large, in a right triangle, post-ocellar and ocello-ocular distances equal. Antennae slender, the first four segments in a ratio of about 3:1:3:3, segment three about 3.2 times as long as thick. Pronotum feebly angulate behind; propodeum with a faintly impressed median line. Third submarginal cell of the fore wing petiolate by one-third of its height.

Subgenital plate (Fig. 2) of moderate breadth, the apex broadly rounded, the median line not elevated. Genitalia (Fig. 1) with the parameres long, slender, slightly curved, sparsely clothed with setae. Volsellae with two very long setae at the base of the digitus, the latter expanded apically, somewhat triangular, clothed with setae which are longest at the outer angles. Aedeagus rather broad, the apex weakly bilobed.

Female: Length 12 mm.; fore wing 9.5 mm. Color black, the entire body rendered rather conspicuously deep bluish by the pubescence. Wings fuscous, a little darker along the outer margin, violaceous. Front, vertex, and front coxae with numerous dark setae; pronotum, mesonotum, scutellum, mesopleura, and sides of the propodeum very slightly hairy.

[1] Latin **grandis**+**flexionis**, of the Big Bend.

Clypeus 2.6 times as broad as high, its apical margin truncate. Front narrow, its greatest breadth .53 times the maximum breadth of the head. Eyes slightly convergent above, the distance between the eyes at the top .83 times the distance between them at the bottom. Ocelli forming an acute angle in front; post-ocellar and ocello-ocular distances equal. First four antennal segments in a ratio of about 6:2:9:7, the third segment equal to .95 times the distance between the eyes at the top.

Posterior pronotal margin feebly angulate. Propodeum short, with a somewhat flattened declivity behind, its median line weakly impressed in front. Spines of the tarsal comb about as long as the width of the tarsus. Third submarginal cell of the fore wing short-petiolate. Abdomen subfusiform, the apical tergite strongly bristly.

Five female paratypes vary in length from 10 to 13 mm.; in older specimens the color of the pubescence has faded to violet. The third submarginal cell is triangular in all of the paratypes, but petiolate in only one.

Holotype: TEXAS: Jeff Davis Co. ♂, Fort Davis, 5000 feet, 26 July 1946 (H. E. Evans; taken on dried leaves in an arroyo). **Allotype:** ♀, same data as type. [These two specimens will be deposited in the United States National Museum].

Paratypes: 1 ♀, same data as type [Coll. of author]. 1 ♀, 6-10 mi. west of Fort Davis, on Texas Route 166, 15-23 July 1948 (H. E. Evans & G. E. Ball; on flowers of **Sphaeralcea angustifolia**) [Will be deposited in the California Academy of Sciences]. Brewster Co. 1 ♀, The Basin, 5400 feet, Chisos Mts., Big Bend National Park, 8-14 July 1948 (H. E. Evans; on ground in a shaded arroyo) [Academy of Natural Sciences of Philadelphia]. NEW MEXICO: Sandoval Co. 1 ♀, Jemez Springs, 7 August 1916 (John Woodgate) [Cornell University]. 1 ♀, same data but 21 July 1916 [Museum of Comparative Zoology].

Anoplius (Pompilinus) percitus n. sp.[2]

(Fig. 3)

Pompilinus subcylindricus Dreisbach, 1949, Ent. Americana, 29: 31, 42, and pl. V, figs. 25, 26. [Nec Banks; misidentification].

Male: Length 6 mm.; fore wing 5 mm. Color black; wings hyaline, the fore wing with a broad fuscous band along the outer margin. Pubescence brownish cinereous, grading into silvery on the front, clypeus, pronotum, coxae, meso- and metapleura, sides of the scutellum, metanotum, and propodeum. Front, vertex, and anterior coxae very slightly hairy; fourth and to a lesser extent the fifth abdominal sternites with dense mats of very short, suberect setulae.

Clypeus slightly more than twice as broad as high, its apical margin truncate. Front broad, at its widest .61 times the maximum width of the head; inner orbits subparallel. Ocelli in about a right triangle, the post-ocellar distance slightly greater than the ocello-ocular. Antennae slender, the first four segments in a ratio of about 9:4:10:9, the third segment about three times as long as its greatest thickness.

[2] Latin **percitus**, very excitable.

Posterior pronotal margin angulate. Median length of the postnotum slightly over half that of the metanotum. Median line of propodeum lightly impressed. Marginal cell of fore wing nearly twice its own length from the apex of the wing; third submarginal cell petiolate.

Subgenital plate narrow, its median line somewhat elevated, the disc clothed with short, suberect setulae. Genitalia (Fig. 3) with the parameres slender, curved, clothed ventrally with coarse setae. Volsella with several setae on the base, one of which is very long; digitus subfusiform, the inner margin nearly straight, the outer margin strongly arched, the apex acute but less attenuate than in **subcylindricus**, and without the short setae of that species; disc of digitus clothed with small setae, the upper outer margin with several long setae which are only very slightly sinuous apically. Aedeagus with its sides arcuately expanded to a point about three-fourths the distance from the base, then narrowed, the apex feebly bilobed.

Twenty-six male paratypes vary in length from 5 to 8.5 mm., and show only minor differences from the type; in some the eyes diverge very slightly above, and in most of them the post-ocellar and ocello-ocular distances are about equal.

Female: Length 6 mm.; fore wing 5 mm. Color black; front wings lightly infuscated, darker beyond the cells; hind wings hyaline, darker apically. Pubescence wholly brownish-cinereous. Front and vertex with sparse short, dark setae; pronotum and front coxae slightly hairy; abdominal sternites beyond the first and the last two tergites somewhat setose, the apical tergite also with several bristles.

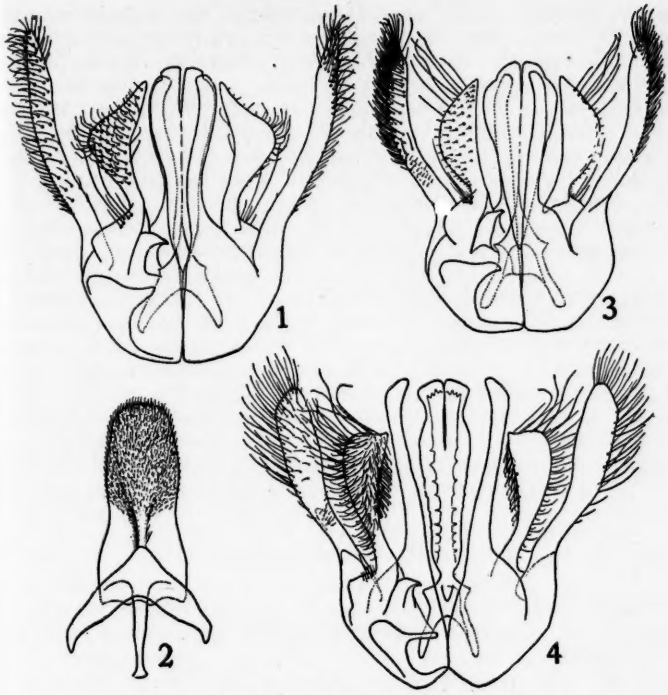
Head rather broad, the vertex raised slightly, arcuately above the tops of the eyes. Clypeus 2.7 times as broad as high, its apical margin truncate. Front very broad, at the middle .62 times the maximum width of the head. Ocelli in a right triangle, the post-ocellar and ocello-ocular distances equal. In lateral view, the front strongly convex, the temples about half the width of the eyes. First four antennal segments in a ratio of about 8:3:10:9, segment three thus shorter than one and two together, and this segment equal to .67 times the distance between the eyes at the top.

Posterior margin of pronotum broadly but distinctly angulate. Propodeum short and convex, with an oblique, slightly concave posterior declivity. Spines of the tarsal comb about as long as the width of the tarsus.

Fifty-two female paratypes vary in size from 6 to 9.5 mm. The maximum breadth of the front varies from .60 to .64 times the maximum breadth of the head. The third antennal segment varies from .55 to .8 times the distance between the eyes at the top.

Holotype: NEW YORK: Tompkins Co. ♂, Ithaca, on sand, 27 July 1947 (H. E. Evans). **Allotype:** ♀, same data as type except taken 3 August 1947. [These two specimens will be deposited in the United States National Museum].

Paratypes: 1 ♀, 1 ♂, Ithaca, 5 July & 10 August [Cornell University]. Chautauqua Co. 1 ♀, Bemus Point, 15 July 1937, on wild parsnip flowers at dusk (H. K. Townes) [Cornell U.]. Chemung Co. 1 ♂, Elmira, 29 July 1938 (H. I. Scudder) [Cornell U.]. Dutchess Co. 1 ♀, Poughkeepsie, 24 July 1936 (J. G. Franclemont) [Coll. K. V. Krombein]. Greene Co. 1 ♂,



EXPLANATION OF FIGURES

Figure 1. Male genitalia of **Anoplius (Pompilinus) grandiflexionis** n. sp. Figure 2: Male subgenital plate of **A. (P.) grandiflexionis** n. sp. Figure 3: Male genitalia of **A. (P.) percitus** n. sp. Figure 4: Male genitalia of **A. (P.) krombeini** n. sp. In the figures of the genitalia, the ventral aspect is shown on the left side, the dorsal on the right.

June [Carnegie Museum]. Essex Co. 1 ♀, Mt. McIntyre, 27 August 1940 (H. Dietrich) [Cornell U.]. New York City 1 ♀, Hunter's Island, 3 Sept. 1942 (R. Schuster) [Cornell U.]. Suffolk Co. 1 ♂, Babylon, 17 July 1937 (F. S. Blanton) [California Academy of Sciences]. Westchester Co. 1 ♂, Millwood, 21 June 1936 [Cornell U.]. "Long Island" 1 ♂ [U.S. National Museum]. MASSACHUSETTS: Hampshire Co. 2 ♀♀, 1 ♂, Amherst [U. Massachusetts]; 1 ♀, Cummington, 31 Aug. 1947, on flowers of **Solidago** (H. E. Evans) [Coll. author]. Middlesex Co. 1 ♀, Melrose Highlands, 10 Aug. 1915 (F. X. Williams) [California Academy of Sciences]. Suffolk Co. 1 ♀, Boston, 30 August 1914 (F. X. Williams) [Calif. Academy of Sciences]; 3 ♀♀, Forest Hills, 30 August 1914 (F. X. Williams) [Calif. Academy of Sciences]. CONNECTICUT: Hartford Co. 9 ♀♀, 1 ♂, East Hartford, on banks of Con-

necticut R., on flowers of **Daucus carota, Solidago, and Anaphalis margaritacea,** 13 June-20 Sept. (H. E. Evans) [Coll. author, Academy of Natural Sciences of Philadelphia, and Museum of Comparative Zoology]. NEW JERSEY: Burlington Co. 1 ♀, 3 ♂♂, Riverton, 14 July-29 Sept. [U.S. National Museum]; 1 ♀, Bridgeboro, 8 Sept. 1926 (H. W. Allen) [U.S. National Museum]. PENNSYLVANIA: Allegheny Co. 1 ♀, Pittsburgh, July [Carnegie Museum]; 1 ♀, Sample Station, 22 Aug. 1909 (H. Kahl) [Carnegie Museum]; 1 ♀, Braddock, 17 Aug. 933 (H. A. Scullen) [Oregon State College]. Dauphin Co. 1 ♀, Highspire, 4 Sept. 1909 (W. S. Fisher) [U.S. National Museum]. Philadelphia 1 ♀ Lawndale, 15 Sept. 1901 [Academy of Natural Sciences of Philadelphia]. MARYLAND: Montgomery Co. 4 ♀♀, 1 ♂, Glen Echo, Summer 1917 & July 1927 (R. M. Fouts) [U.S. National Museum]. DISTRICT OF COLUMBIA: 12 ♀♀, 9 ♂♂, Washington, 30 June-14 Sept. (M. S. Vogel & R. Boettcher) [Coll. M. S. Vogel and of author]. VIRGINIA: 1 ♂ (no further data) [Univ. Minnesota]. Fairfax Co. 1 ♂, Falls Church, 30 Aug. (N. Banks) [Museum of Comparative Zoology]; 1 ♀, E. Falls Church, 24 Sept. (S. A. Rohwer) [U.S. National Museum]; 1 ♀, Dunn Loring, 30 Aug. 1947 (K. V. Krombein [Coll. K. V. Krombein]; 1 ♀, Clifton, 30 June 1935 (K. V. Krombein) [Coll. K. V. Krombein]. ALABAMA: 1 ♀, Tuscaloosa, 4 Oct. 1947 (R. L. Chermock) [Coll. author]. TEXAS: Brazos Co. 1 ♀, 1 ♂, 10 Oct. 1938, on goldenrod (J. E. Gillaspy) [Coll. J. E. Gillaspy].

Anoplius (Pompilinus) krombeini n. sp[3]

(Fig. 4)

Male: Length 6.2 mm.; fore wing 4.7 mm. Color black; wings nearly hyaline, with a brownish outer marginal band. Pubescence brownish, becoming silvery on the scape below, the clypeus, lower front, temples, front and sides of the pronotum, coxae, pleura, and propodeum. Clypeus, front, and vertex with a very few short setae; abdominal sternite four with a brush of suberect setae of moderate length (longer than in **percitus** or **subcylindricus,**) and sternite five and the subgenital plate with shorter, suberect setulae.

Clypeus a little over twice as broad as high, its apical margin slightly arcuately concave. Front rather narrow; inner orbits diverging very slightly above. Ocelli forming a right triangle, the ocello-ocular and post-ocellar distances about equal. Antennae very slender, the first four segments in a ratio of about 3:1:3:3, the third segment three times as long as thick.

Posterior margin of pronotum distinctly angulate. Postnotum medially nearly as long as the metanotum. Propodeum with a weakly impressed median line, its slope very low, only slightly steepened behind. Marginal cell of fore wing nearly twice its own length from the apex of the wing; third submarginal cell petiolate.

Subgenital plate of moderate breadth, the median line distinctly ele-

[3] Named for Mr. Karl V. Krombein, of the Division of Insects, U.S. National Museum, who collected the type and a long series of paratypes of this species near Nags Head, N.C. in the summer of 1948.

vated, the median ridge and the apex clothed with short, suberect setulae; the sides are unpigmented and clothed with very small setae. Genitalia (Fig. 4) with the parameres broadened apically, subclavate, clothed ventrally and along the outer margin with sparse long setae. Volsella with a group of small setae on the base, one of which is a little longer than the others; digitus gradually expanded to the apex, which is rounded on the outer side, acute at the inner angle; the digitus is clothed with rather long setae which are angled at their apices, and on the outer, upper portion are a number of much longer, somewhat sinuate setae. Aedeagus slender, the apex with two somewhat truncate lobes, between which it is deeply cleft.

Twenty-one male paratypes vary in length from 6 to 7.5 mm., and resemble the type very closely.

Female: Length 7.8 mm.; fore wing 6.2 mm. Color black; wings lightly infuscated, somewhat darker along the outer margins. Pubescence wholly brownish. Front and vertex with a few weak setae; front coxae with strong setae in front and finer hairs behind; abdominal venter and apical tergites more or less setose, the apical tergite with numerous strong bristles.

Clypeus 2.5 times as broad as high, its apical margin distinctly but not deeply arcuately concave. Front very narrow, at its widest .55 times the maximum width of the head; inner orbits converging slightly above. Vertex not at all elevated above the tops of the eyes; ocelli as in male. Antennae slender, the first four segments in a ratio of about 9:3:12:11, the third segment about .85 times the distance between the eyes at the top.

Posterior pronotal margin angulate; postnotum about half the length of the metanotum. Propodeum relatively long, the declivity ill-defined and not steep; median line vaguely impressed. Spines of the tarsal comb about as long as the width of the tarsus. Venational characters as in male.

Twenty-four female paratypes vary in length from 6 to 10 mm., and compare closely with the allotype; the greatest breadth of the front varies from .53 to .56 times the maximum breadth of the head, the front thus always quite narrow.

Holotype: NORTH CAROLINA: Dare Co. ♂, Kill Devil Hills, 28 May 1948 (K. V. Krombein). **Allotype:** ♀, same data as type. [These two specimens will be deposited in the United States National Museum].

Paratypes: 19 ♀♀, 15 ♂♂, same data as type but dates varying from 25 May to 3 June 1948 [Coll. K. V. Krombein, author, U.S. National Museum, and Museum of Comparative Zoology]. NEW JERSEY: Atlantic Co. 1 ♂, Weymouth, 27 June 1926 (J. C. Bradley) [Cornell U.]. Burlington Co. 1 ♀, Brown's Mills, 3 Sept. 1923 [U.S. National Museum]. FLORIDA: 1 ♀ (no further data) [Academy of Natural Sciences of Philadelphia]. Clay Co. 1 ♀, Hibernia, 7 Aug. 1939 (A. T. Hardy) [U. Kansas]. Collier Co. 1 ♀, 10-40 mi. E. of Everglade, 30 Aug. 1931 (Bradley & Knorr) [Cornell U.]. Hendry Co. 2 ♀♀, 1 ♂, La Belle, 8-10 April 1937 (H. I. Scudder) and 8-10 May 1916 (J. C. Bradley) [Cornell U.]. Lee Co. 1 ♂, Sanibel Island, 13 May 1916 (J. C. Bradley) [Cornell U.]. Orange Co. 1 ♂, Orlando, 4 Apr. 1944 (J. E. Gillaspy) [Coll. J. E. Gillaspy]. Polk Co. 1 ♂, Lakeland, 10 Nov. 1911 [American Museum of Natural History].

NEW NORTH AMERICAN PHYLLOPHAGA (SCARABAEIDAE)

MILTON W. SANDERSON
Illinois Natural History Survey, Urbana, Illinois

In the course of making some miscellaneous identifications of **Phyllophaga** in the collections of the University of Kansas and the University of Michigan, two undescribed species from Florida were found. Their descriptions are presented together with the description of a new species from Fayetteville, Arkansas. One individual only of the latter was taken during a five year residence in Arkansas although many light trap and host plant collections were made, especially in the vicinity of Fayetteville. I believe that there are other North American species of this genus to be discovered by extensive local collecting, chiefly by making continuous light trap collections and systematic host collections at night throughout several seasons.

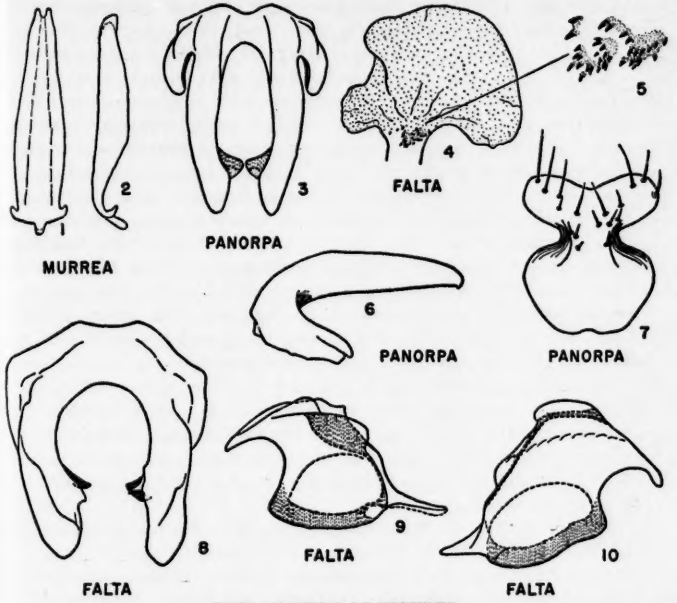
Phyllophaga murrea n. sp.

This species is known from a single female which closely resembles the female of **elongata** Linell. The genitalia, however, show a closer relationship to **congrua** LeConte.

Female: Length 16 mm.; width 7 mm. Color reddish brown, the head darker than pronotum, and pronotum darker than elytra. Entire dorsum clothed with very fine short semi-erect hairs, those on pronotum and elytra separated by approximately the length of each hair; surface above shining. Antenna 10-segmented, club slightly less than length of preceding six segments combined but equal in length to clypeus at middle. Clypeus slightly emarginate and reflexed; surface finely punctured, the punctures separated by about their diameters or slightly more; punctures on head a little larger and more closely placed. Pronotum with lateral margins even, parallel to the rectangular base behind middle. Scutellum more closely punctured than pronotum or elytra. Pygidium with length and width subequal, surface finely and closely punctured and clothed with fine and short semi-erect hairs; apex rounded. Abdomen unmodified. Anterior tibia distinctly tridentate; tarsal claws each with a short rather narrow intramedian tooth equal in length to about one-third or one-fourth upper tooth; apexes of posterior tibiae each with 22 and 24 marginal spinules. Metasternum nearly uniformly finely and closely punctured with hairs equal to about one-third greatest width of posterior femur. Pubic process of genitalia (figs. 1 and 2) elongate, the sides parallel in basal third then narrowed to a narrow emarginate apex; base enlarged and curved in lateral aspect; plates simple, scarcely at all modified.

Holotype female, Polk Co. Florida, Lake Streaty, September 10, 1938, Hubbell and Friauf. Dr. Hubbell wrote that this individual and other insects were collected at night with automobile headlights, beating scrub oaks and other vegetation, between 10:00 p.m. and 1:00 a.m. Type in collection of University of Michigan.

The female is readily distinguished from **congrua** by its hairy instead of glabrous upper surface, the shorter tooth on the tarsal claw, which in



EXPLANATION OF FIGURES

1. Phyllophaga murrea n. sp. Pubic process of female genitalia, ventral view.
2. Phyllophaga murrea n. sp. Pubic process of female genitalia, lateral view.
3. Phyllophaga panorpa n. sp. Male genitalia, caudal view.
4. Phyllophaga falta n. sp. Aedeagus of male genitalia.
5. Phyllophaga falta n. sp. Enlargement of group of spines on aedeagus.
6. Phyllophaga panorpa n. sp. Male genitalia, lateral view.
7. Phyllophaga panorpa n. sp. Pubic process of female genitalia, ventral view.
8. Phyllophaga falta n. sp. Male genitalia, caudal view.
9. Phyllophaga falta n. sp. Male genitalia, right lateral view.
10. Phyllophaga falta n. sp. Male genitalia, left lateral view.

congrua is equal in length to about one-half the upper tooth, and in details of the pubic process of the genitalia. The process in **congrua** narrows rather suddenly from the base (see Langston, 1927, fig. 13, p. 81). The female of **elongata** resembles **murrea** but has the pubic process of the genitalia very short and broad, similar to that of **panorpa.**

Phyllophaga panorpa n. sp.

Closely related only to **elongata** Linell, it occurs also in Florida.

Male: Length 18 mm.; width 8.5-9 mm. Color light reddish brown, the head and pronotum a little darker and more shining than elytra. Entire dorsum clothed with very short, closely placed, semi-erect yellowish hairs; surface above slightly pruinose. Antenna 10-segmented, club yellowish and a little longer than stem, about three times longer than clypeus at middle.

Clypeus distinctly emarginate, front margin conspicuously reflexed; surface finely and rather closely and evenly punctured, the punctures separated by an average of once their diameters; punctures of head of same size, more closely placed. Pronotum with sides behind middle straight and parallel; side margins gradually rounded to the narrower front angles, finely crenulate; punctures very fine, almost evenly spaced and separted by approximately their own diameters. Elytra and scutellum as finely punctured as pronotum. Pygidium very convex, length and width subequal, finely and closely punctured and with short semi-erect hairs. Abdomen flattened and somewhat concave, the last sternite shallowly depressed; surface of abdomen conspicuously raised at the bases of each fine and short hair. Anterior tibia tridentate; tarsal claw slender, generally without a tooth; posterior tibia with one very short spur immovably attached; apex of tibia with 36 to 40 spinules.

Female: Length 16 mm. Very similar in appearance to males except for its slightly shorter size. Sides of pronotum less parallel in basal half than in males but more gradually curved from the slightly narrowed base to apex. Antennal club much shorter than that of male, approximately equal in length to six preceding segments combined, or to clypeus at middle. Abdomen somewhat flattened and almost like that of male. Each tarsal claw with a very distinct lower tooth a little nearer base than apex; tooth about one-third or one-fourth length of apex of claw. Apex of posterior tibia with 39 and 40 marginal spinules.

Holotype male, allotype female, and four paratype males, Lake Placid, Florida, July 13, 1948, H. W. Crowder, R. H. Beamer; paratype male, Polk Co. Florida, August 10, 1938, Hubbell and Friauf. Holotype, allotype and paratype in the Snow Collection, University of Kansas. Paratypes in the collection of the Illinois Natural History Survey. Polk Co. paratype in the collection of the University of Michigan.

The tarsal claws of three of the six males examined were entirely without lower teeth. In other males one or more of the claws had a faint indication or a very short triangular swelling near base. This species is very closely related to **elongata,** having the same type of symmetrical genitalia. The apex of the clasper of **panorpa** (fig. 3) is convex on the inner margin but in **elongata** it is straight or slightly concave. The aedeagi of the two species are very similar. The pubic processes of the female of **panorpa** (fig. 7) are united into a single structure which is rather shallowly emarginate at the apex. The emargination in **elongata** is deeply angulate. The males of **panorpa** are darker and longer than **elongata,** averaging 18 mm., the males of **elongata** averaging about 14 mm. In addition the **panorpa** males do not have a well developed tooth on the tarsal claw as in **elongata.**

The non-toothed tarsal claw is a character also found in the Puerto Rican **Abcrana crinitissima** (More), a species originally described in **Phyllophaga.**

Phyllophaga falta n. sp.

This species is almost indistinguishable from the widespread **fervida** Fibricius except for a little difference in position of the transverse ridge on the penultimate abdominal sternite, and abundant differences in the claspers and aedeagus of the male genitalia.

Male: Length 19 mm.; width 10 mm. Color dark chocolate brown, shining and glabrous above. Antenna 10-segmented. One spur of posterior tibia immovable and similar to that of **fervida**. Claws of two species exactly similar. Ridge of penultimate abdominal sternite excavated and depressed at middle, more sharply raised at both ends with a slight excavation behind each end; ridge distinctly more advanced at middle than at ends and located about half way between anterior and posterior margins of sternite. Claspers of genitalia (fig. 8) asymmetrical, the left clasper (fig. 10) somewhat resembling that of **fervida** when viewed from the side. Aedeagus with two groups of very short stubby teeth or spines on membrane at base of apical swelling.

Holotype male, Fayetteville, Arkansas, May 18, 1942, M. W. Sanderson, light trap. In collection of Illinois Natural History Survey.

The only male examined was taken with **fervida** in the same light trap. Subsequent collections at the light and on various trees and shrubs the following nights failed to produce more individuals. The ridges on the penultimate sternites of this species and **fervida** are very similar but the ends of the ridge reach or overhang the posterior margin in the latter species. The claspers are somewhat alike but there are many differences in detail as shown in the illustrations. There are striking differences in the aedeagi of the two species; **fervida** has many large curved spines on the evanginated membrane (Jour. Kans. Ent. Soc. 12 (1): 15: fig. 7, 1939). These are absent in **falta** but there are two groups of short spines, one on each side, at base of swelling as shown in fig. 5.

ON THE DISTRIBUTION OF NOTONECTA PETRUNKEVITCHI Hutchinson (HEMIPTERA-NOTONECTIDAE)

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University of Kansas, Lawrence

In 1945 Doctor G. Evelyn Hutchinson* described **N. petrunkevitchi** from Connecticut, Massachusetts and New Jersey. He suggested that a specimen with rounded mesotrochanter that I had mentioned in my discussion of **Notonecta raleighi** Bueno in "The Notonecta of the World,"† 1934, probably belonged to his new species. A re-examination of this specimen, which is a male and was taken at "So. Pines, N. C. in June 1909," proves to be **N. petrunkevitchi** Hutchinson. A recent study of the **N. raleighi** complex of material that has been received by our museum since "The Notonecta of the World" paper went to press brings to light a series of specimens taken at Fryeburg, Maine, by P. McKinstry and M. E. Griffith on August 20, 1934. This lot contains **Notonecta lunata** Hungerford, 2 males and 9 females, and **Notonecta petrunkevitchi** Hutchinson, 10 males and 13 females.

The two species were reported by Hutchinson as sometimes occurring in the same pond and it is probable that a re-examination of other collections of **Notonecta lunata** Hungerford and **Notonecta raleighi** Bueno will turn up additional records of **Notonecta petrunkevitchi** Hutchinson.

*Trans. Conn. Acad. of Arts and Sciences 36: 599-605.
†Univ. of Kansas Science Bull. 21: 106.

CATALLAGIA MATHESONI, A NEW HYSTRICHOPSYLLID FLEA (SIPHONAPTERA) FROM CALIFORNIA

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The following new species of **Catallagia** Rothschild (Hystrichopsyllidae, Neopsyllinae) is one of several kinds of fleas found on small mammals in the Sierra Nevada of California. Although some of the currently accepted species of **Catallagia** may eventually be placed in the synonomy of earlier names, this new species is quite distinct from those illustrated by Hubbard (1947:285). Hubbard discussed all the species except **borealis** Ewing, an eastern species quite unlike the western group of species.

Catallagia mathesoni, n. sp.

Catallagia mathesoni can be easily separated from all other members of the genus by the modified segments of the male. The females of this genus are difficult to identify: the outline of sternite VII, so useful as a diagnostic character in some genera of fleas, must be used with reservation in **Cattalagia;** the seminal receptacle is a helpful recognition character. In view of the above-mentioned paper on this genus, I shall not discuss the relationship of **mathesoni** to all the previously named forms. **C. mathesoni** does not appear to be closely allied to any known species of **Catallagia.**

Male head (Fig. 1, A): The shape of the head shows the usual sexual dimorphism found in fleas, but the chaetotaxy in both sexes is the same. Preantennal region with two rows of bristles: the anterior row with five bristles; and the posterior row with four, much heavier bristles, the bristle ventrad from the uppermost being much reduced. Between the two lowest bristles are two or three very fine setae. Bristles of antennae short in the male; in the female those of segment II slightly longer. Antennal groove bordered by about seven or eight small setae. Postantennal region with three rows of bristles, each row of five bristles decreasing in size dorsally.

Thorax: Pronotum (Fig. 1, A) with a row of bristles and a comb of fifteen or sixteen ctenidia. Mesonotum and metanotum each with three rows of bristles, but without apical spinelets.

Legs: Coxa I with setae as illustrated (Fig. 1, A); coxae III and II of decreasingly pilosity in that order. Coxa III (Fig. 1, C) with a mesal patch of about 20 small setae in two irregular rows, slenderer ventrally. Prefemora with seven to ten fine bristles on the mesal side, mesofemora with one, and metafemora with none. Four pairs of lateral plantar bristles and a basal ventral pair on the fore- and mesotarsi, and four pairs of lateral plantar bristles on the metatarsus.

Abdomen: First four terga each with one or two apical spinelets to a side. Antepygidal bristles three, the central the longest, the lower slightly smaller than the upper. Spiracular opening subequal to the pygidium.

Modified segments, male (Fig. 1, D-F): Eight sternite bilobed apically, the upper lobe hyaline and acute, the lobes without setae. Process of the clasper entire, with a row of fine bristles dorsally, and four or five bristles on the vertical border. Movable finger of exopodite (Fig. 1, E) four-sided,

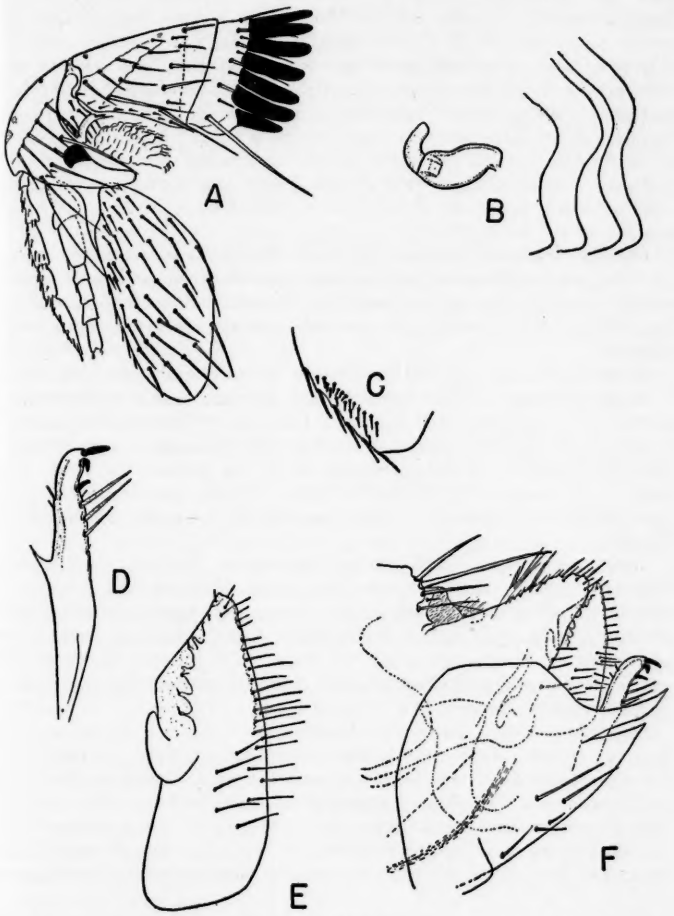


Fig. 1. **Catallagia mathesoni,** n. sp. A, head of male; B, seminal receptacle and outline of seventh sternite of female; C, distal part of coxa III of female, mesal view; D, sternite IX of male; E, movable finger of exopodite; F, genitalia of male.

the upper two-thirds of the caudal border with a row of fine setae, and five to seven similar setae somewhat forward of the caudal border, laterally. Distal arm of sternite IX (Fig. 1, D) with three spiniforms, the position and shape of which are quite characteristic of this species: the apical is the longest and is straight, the penultimate is shorter, more pointed, and bent sharply ventrad. The third spiniform is somewhat apart from the first two, and about half the size of the first. Below these spiniforms are three or four long, slender bristles. The distal arm is straight, and bears two small bristles and an acute lobe anteriorly. There is a small mesal patch of four to six slender bristles, not shown in the illustration. Manubrium slender and even, turned dorsally at the apex. Penis with a mesal swelling and with an acute apical hook. Springs curved dorsally, ending above the swelling of the penis.

Modified segments, female (Fig. 1, B): Sternite seven with the margin undulate, with no sharp angle to the lobe. Seminal receptacle as illustrated, concave dorsally and convex ventrally. Sternite eight with four or five large bristles along the apical border; the apex slightly greater than ninety degrees.

Type locality: Quincy, Plumas County, California; altitude 3600 feet.

Types: Holotype male, allotype female, and paratypes from **Peromyscus boylii** (Baird) with the following data: Holotype 18 February 1949, allotype 19 November 1948, paratypes 9 December 1948 (three males), 16 February 1949 (one female), 19 February (one male, one female), 19 April (four males, five females), 6 March (one female), 7 March (one female), 8 March (two males, one female), 11 March (one female), 1 April (one male, one female).

Additional records: Clethrionomys californicus (Merriam) 14 November 1948 (one male); **Microtus montanus** (Peale) 23 March 1949 (one male); **Neotoma fuscipes** Baird 29 March 1949 (one male); **Sorex trowbridgii** Baird 29 October 1948 (one male), 28 December (one female), 12 January 1949 (one male), 9 March (one male), 22 March (one female), 23 March (one male). All the above specimens from within five miles of the type locality; collected by the writer.

Remarks: A type host is not designated. In many fleas two or more species of hosts are commonly parasitized; and in many instances these hosts are quite unrelated. Such a situation obtains in the host distribution of **C. mathesoni.** To indicate a type host might seem to infer that specimens from any other hosts were strays.

This flea is named for Professor Robert Matheson who, through his students, has done much to further the study of North American Siphonaptera.

LITERATURE CITED

Hubbard, Clarence Andresen 1947. Fleas of western North America. The Iowa State College Press, 533 pp.

THE GENUS LAGOPOECUS (PHILOPTERIDAE: MALLOPHAGA) IN NORTH AMERICA

K. C. EMERSON
Oklahoma A. and M. College, Stillwater.

Lagopoecus Waterston 1922

Ent. Mon., Mag., LVIII, p. 159.

Genotype: **Lagopoecus lyrurus** Clay 1938. **Proc. Zool. Soc. Lond., Ser. B,** CVIII, p. 187. **(Nom. nov. for Lagopoecus cameratus** (Burmeister, 1839), preoccupied).

Description of the genus

Head circumfasciate. Antennae filiform in both sexes. Eye prominent, with a long seta arising from the dorsal surface. Temples convexly rounded, each with two long setae; cephalic margin without setae.

Prothorax short, wide, and armed dorsally with one long seta on each posterolateral angle. Pterothorax short, wide, and with dorsal posterior pterothoracic setae. Legs short.

Abdomen short and wide. Tergal plates with median setae; long setae in the posterolateral angles; and post spiracular setae. Sternal plates with a pair of median setae.

Male genitalia simple.

Discussion of the genus

Within the genus, the North American species fall roughly into two group. The members of one group, **L. gambellii** and **californicus**, have a pointed clypeal margin; and except for the filiform antennae might be placed in the genus **Colinicola.** In the other species, the clypeal margin is rounded, and they resemble each other very much, forming a very compact group. The chaetotaxy, male genitalia, and size can only be illustrated to show differences between the species. These differences cannot be adequately described, therefore no attempt has been made to separate the species in a key. It is believed that plates I and II will illustrate adequate differences for separation. All figures on plate I are drawn to the same scale; hence, differences in size, shape, and chaetotaxy are very readily noticed. These figures are the dorsal view; of the head in outline, the thorax, and the first four abdominal segments. The dorsal chaetotaxy of the remaining abdominal segments is the same as that found on the third or fourth segments. The ventral abdominal chaetotaxy is similar for all species and has not been used in this study. All figures of the male genitalia on plate II are drawn to the same scale.

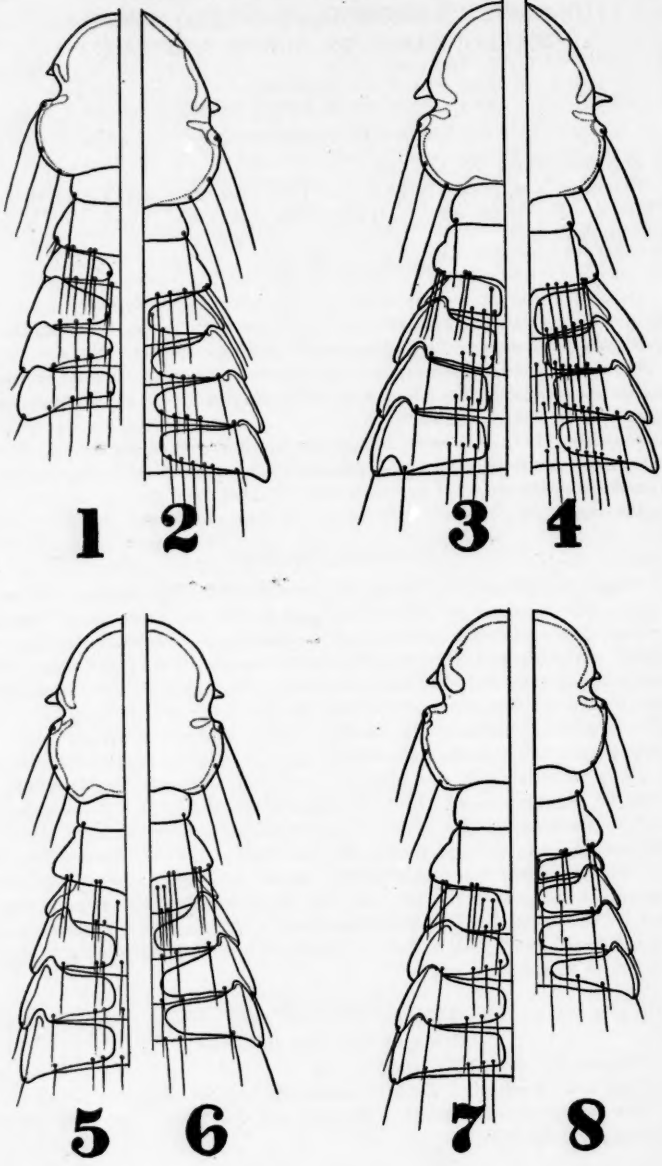
Lagopoecus gambellii Emerson 1949

(Plate I, figure 4; Plate II, figure 5)

J. Kans. Ent. Soc., XXII, p. 75, f. 3-5.

Type host: **Lophortyx gambellii gambellii** Gambel, Gambel's Quail.

The type series collected in Tucson, and the Santa Rita Reservation, Arizona; was studied.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Lagopoecus californicus (Kellogg and Chapman 1899)
(Plate I, figure 2; Plate II, figure 4)

Occ. Papers Calif Acad. Sci., VI, p. 103.

Type host: **Oreortyx picta picta** (Douglas), Plumed Mountain Quail.

Material examined was collected from the type host collected in California.

The species has been recorded from: **Oreortyx picta picta** (Douglas), Plumed Mountain Quail, collected in Nevada; and **Oreortyx picta palmeri** Oberholser, Northwestern Mountain Quail, collected in California.

Lagopoecus affinis (Children 1836)
(Plate I, figure 1; Plate II, figure 1)

App. Bach's Arctic Land Exp., p. 537.

Nirmus cameratus var. **nigrescens** Evans 1912. **Scott. Nat.,** p. 280.

Nirmus protervus Kellogg 1899. **Occ. Papers Calif. Acad. Sci.,** VI, p. 31, Pl. III, f. 4.

Type host: **Lagopus lagopus lagopus** (Linnaeus).

The material examined was from the following collections: **Lagopus lagopus albus** (Gmelin), Keewatin Willow Ptarmigan—Craig Harbour and Pangnirtung, N.W.T.; Les Pas, Manitoba; and Kapuskesing, Smoky Falls and Cape Henrietta Maria, Ontario. **Lagopus lagopus alexandrae** J. Grinnell, Alexander's Ptarmigan—Kodiak Island, Alaska. **Lagopus lagopus leucopterus** Taverner, Baffin Island Ptarmigan—Lake Harbour, Baffin Island. **Lagopus lagopus alascensis** Swarth, Alaska Willow Ptarmigan—Point Barrow, Alaska.

Lagopoecus colchicus (Emerson 1949)
(Plate I, figure 3, Plate II, figure 3)

J. Kans. Ent. Soc., XXII, p. 78, f. 6.

Type host: **Phasianus colchicus torquatus** Gmelin, Ring-necked Pheasant.

Material was studied which had been collected from the type host in Logan, Utah; Williamston, Michigan; Homer, and Urbana, Illinois; and Hamilton, and Lake County, Montana.

Lagopoecus gibsoni (Hopkins 1947)
(Plate I, figure 5; Plate II, figure 7)

Ann. Mag. Nat. Hist., ser. 11, XIII, p. 172, f. 1-3.

Type host: **Centrocercus urophasianus** (Bonaparte), Sage Grouse.

Material was studied which had been collected from the type host in Fergus and Ravalli Counties, Montana; Burns, and Lake County, Oregon; Dixon, Wyoming; and Mayfield, Idaho.

Lagopoecus obscurus (Emerson 1948)
(Plate I, figure 6; Plate II, figure 2)

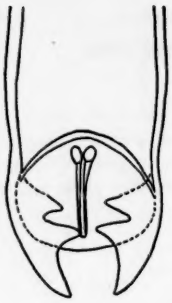
J. Kans. Ent. Soc. XXI, p. 137, Pl. I, f. 1-3.

Type host: **Dendragapus obscurus richardsonii** (Douglas), Richardson's Grouse.

EXPLANATION OF PLATE I

Figures 1-8. Dorsal view in outline of the female head, thorax and first four abdominal segments of **Lagopoecus spp.**

1. **affinis** (Children).
2. **californica** (Kellogg and Chapman).
3. **colchicus** Emerson.
4. **gambelii** Emerson.
5. **gibsoni** Hopkins.
6. **obscurus** Emerson.
7. **perplexus** (Kellogg and Chapman).
8. **umbellus** n. sp.



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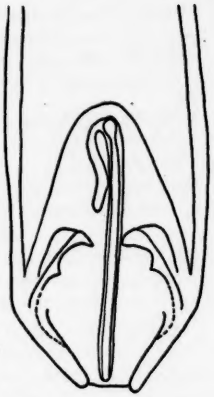

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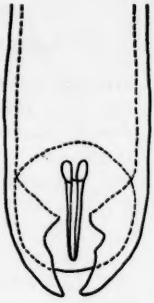

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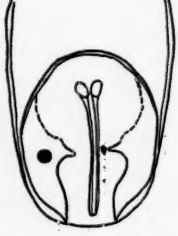

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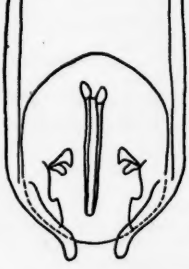

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Material was examined from the following: **Dendragapus obscurus fuliginosus** (Ridgway), Sooty Grouse—Nicola, and Trangville, British Columbia; Conlitz and Okanogan Counties, Washington; and Kings River Canyon, California. **Dendragapus obscurus richardsonii** (Douglas), Richardson's Grouse—Ravalli County, and Florence, Montana.

Lagopoecus perplexus (Kellogg and Chapman 1899)
(Plate I, figure 7)

Occ. Papers Calif. Acad. Sci., VI, p. 103, Pl. VII, f. 5.

Type host: **Pedioecetes phasianellus columbianus** (Ord), Columbian Sharp-tailed Grouse.

The male of this species was not encountered in this study.

Material was examined from the following: **Pedioecetes phasianellus columbianus** (Ord), Columbian Sharp-tailed Grouse—Pullman, Washington. **Pedioecetes phasianellus phasianellus** (Linnaeus), Northern Sharp-tailed Grouse—Kirkland, Ontario.

Lagopoecus umbellus n. sp.
(Plate I, figure 8; Plate II, figure 6)

Female: Head circumfasciate; clypeal margin evenly rounded, and with scattered small setae. Eyes prominent, each with a long seta arising from the dorsal surface. Temples convexly rounded, each with two long setae; caudal margin without setae. Prothorax short, wide, and armed dorsally with one long seta on each posterolateral angle. Pterothorax more than twice as wide as long. Dorsal chaetotaxy of thorax and first four abdominal segments as shown in plate I, figure 8. Abdominal segments with tergal plates as shown in plate I, figure 8. One pair of sternal setae on each abdominal segment. Vulva with a posterior marginal row of short setae.

Male: Head approximately the same size as in the female. Thorax and abdomen essentially the same shape as in the female, but smaller. Chaetotaxy, except for the posterior abdominal segments, same as in the female. Genitalia as shown in plate II, fig 6.

Type host: **Bonasa umbellus** (probably) **phaia** Aldrich and Friedmann, Idaho Ruffed Grouse.

Type material: Holotype male and allotype female and paratypes, collected by S. D. Beak, from the Moscow Mountains, Latak County, Idaho; deposited in the Entomological Collection of Washington State College.

Other material has been examined from the following hosts: **Bonasa umbellus umbellus** (Linnaeus), Eastern Ruffed Grouse—Mifflin County, Pennsylvania; and New York State. **Bonasa umbellus togata** (Linnaeus), St. Lawrence Ruffed Grouse—Brule Lake, Frank's Bay, Buckshot Lake, and the Denora District, Ontario.

EXPLANATION OF PLATE II

Figures 1-7. Male genitalia of **Lagopoecus spp.**

1. **affinis** (Children).
2. **obscurus** Emerson.
3. **colchicus** Emerson.
4. **californicus** (Kellogg and Chapman).
5. **gambellii** Emerson.
6. **umbellus** n. sp.
7. **gibsoni** Hopkins.

THE GENUS BAKERELLA IN NORTH AMERICA NORTH OF MEXICO (HOMOPTERA-FULGORIDAE-DELPHACINAE)

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University of Kansas, Lawrence

The genus **Bakerella** was described by David L. Crawford (Proc. U.S.N.M., Vol. 46, p. 601, 1914) with **Bakerella maculata** Crawf. as the genotype. Beamer described four new species from America North of Mexico (Jour. Kansas Ent. Soc., Oct. 1945) and another new species from the same region (Jour. Kansas Ent. Soc., Oct. 1946). Additional collecting has brought to light seven more new species from the same region which are described here, with a key to the twelve species now known from America north of Mexico.

Key to species of Bakerella

1. Anal segment of male without processes 2
   Anal segment of male with at least one process 3
2. Aedeagus in dorsoventral view with a large retrorse spine on each side near middle ..... **bidens** Beamer
   Aedeagus in dorsoventral view without a large retrorse spine on each side near middle ..... **muscotana** Beamer
3. Anal segment of male usually with one process absent or nearly so; elytra of brachypterous form reaching tip of abdomen 4
   Anal segment of male with a pair of processes; elytra of brachypterous form not reaching tip of abdomen 5
4. Aedeagus almost as long as length of pygofer, sides nearly parallel; elytra of brachypterous form with bullae at apices. ..... **bullata** n. sp.
   Aedeagus many times wider at base than at apex; without bullae on apices of elytra ..... **spinifera** n. sp.
5. Caudoventral margin of pygofer with a long slender dorsally projecting spine ..... **pediforma** n. sp.
   Caudoventral margin of pygofer without a long, slender, dorsally projecting spine 6
6. Anal segment of male with processes long and extremely slender, about as long as width of pygofer ..... **minuta** n. sp.
   Anal segment of male with processes normal 7
7. Anal segment of male with outer surface of processes curved ventrally 8
   Anal segment of male with outer surface of processes straight or excavated 9
8. Aedeagus bent ventrally at about a 45 degree angle on outer third ..... **rotundifrons** Beamer
   Aedeagus bent ventrally at right angle on outer third ..... **angulata** n. sp.
9. Male with a pair of black horns on connective between aedeagus and anal segment ..... **cornigera** n. sp.
   Male without a pair of black horns on connective between aedeagus and anal segment 10

10. Aedeagus in lateral view narrowed on outer half of dorsal margin ..... **fusca** Beamer
    Aedeagus in lateral view narrowed on outer third of ventral margin 11
11. Apex of aedeagus in lateral view slightly enlarged, five large retrorse teeth on outer third of dorsal margin ..... **cinerea** Beamer
    Apex of aedeagus in lateral view not enlarged, apical third with many small retrorse teeth ..... **penefusca** n. sp.

1. **Bakerella bullata** n. sp.

Brachypterous form:

Resembling **Bakerella muscotana** Beamer but all light marks crossing median carinae of clypeus united and elytra with two round bullae at apices. Length ♂ 1.6 mm.; ♀ 1.9 mm.

Structure: Clypeus slightly less than one-fifth longer than greatest width, widest on basal third, strongly narrowed toward each end, strongly tricarinate, median carina divided near union with crown; crown almost twice as long as basal width, carinae distinct; elytra widest near tip of scutellum, slightly longer than abdomen with two bullae on apex of each, veins raised with usual round black puncts scattered over them.

Color: General ground color brown to almost black; clypeus black with four pairs of united light spots crossing median carina, basal half of crown lighter; sometimes carinae of pronotum and scutellum lighter; membrane of elytra semihyaline to more or less infuscated, with a small yellow spot at anterior edge of each bulla.

Genitalia: In lateral view, pygofer of male almost rectangular, caudal margin slightly excavated; anal segment widest at apex, with a long slender, almost straight process on right side, the left one missing; aedeagus long, widest at base, sides almost parallel, curving gently ventrally to rounded apex, with numerous teeth on the ventral margin of anterior half and about four larger, retrorse teeth near middle of dorsal margin; styles widest at base, curving dorsally, sides narrowing to truncated apices. In caudoventral view, aedeagal brace broadly and deeply excavated; styles many times widest near base, strongly narrowed near middle to almost parallel-sided shafts with rounded apices.

Holotype ♂, allotype ♀, 13 ♂♂ and 9 ♀♀ paratypes, Yankeetown, Fla., March 9, 1947, R. H. Beamer; other paratypes: 13 ♂♂ and 12 ♀♀, Yankeetown, Fla., July 7, 1948, R. H. Beamer; 1 ♀, Cedar Keys, Fla., March 8, 1947, L. D. Beamer; 2 ♀♀, Cedar Keys, Fla., 1939, R. H. Beamer; 1 ♀, Slidell, La., June 25, 1948, R. H. Beamer; 9 ♂♂ and 7 ♀♀, Brownsville, Texas, at Boca Chica, December 27, 1945, R. H. Beamer; 4 ♀♀, 23 mi. east of Piney Point, Md., July 12, 1931, P. W. Oman.

Macropterous form:

Like the brachypterous form except with flight wings extending about half their length beyond the abdomen and generally darker in color. The elytra marked as follows: generally light with a broad diagonal black band crossing before middle and covering apical half of clavus, another in region of cross veins crosses the elytra and curves back to outer apical corner with

all apical veins broadly infuscated, giving the outer half of elytra a scalloped appearance.

Holomorphotype ♀ and 18 ♀ paramorphotypes, Slidell, La., June 25, 1948, R. H. Beamer; other paramorphotypes: 2 ♀♀, same place and time, E. L. Todd; 1 ♀, Mandeville, La., June 24, 1948, R. H. Beamer; 1 ♀, Yankeetown, Fla., July 7, 1948, R. H. Beamer.

Types in Snow Entomological Collections; paratypes in E. D. Ball collection, U.S.N.M.

2. **Bakerella spinifera** n. sp.

Brachypterous form:

Resembling **Bakerella bullata** n. sp. but without the bullate spots at the apices of the elytra. Length ♂ 1.5 mm.

Structure: Clypeus about twice as long as greatest width, widest near middle, margins sub-parallel, very slightly narrowed toward each end, definitely tricarinate, median carina divided near union with crown; crown slightly longer than basal width, carina distinct; elytra about twice as long as wide, extending to tip of genital capsule.

Color: General ground color brown to almost black; clypeus brown with semblance of three or more light median spots and about that many lateral spots; elytra with a black spot near tip of scutellum, black diagonal cross bar arising on tip of clavus, crossing wing parallel to scutellum and reaching costal margin, tip of wings from cross veins out also black except large hyaline spot near outer costal margin and two smaller areoles on the apical margin between the veins.

Genitalia: In lateral view, pygofer of male almost rectangular; anal segment small with one long, tapered process on the left side and a mere point on the right; aedeagus many times wider at the base than at apex, narrowed and curved ventrally to rounded apex, anterior outer third thickly covered with retrorse teeth, thickest near outer third of dorsal margin, dorsal margin with a rounded knob-like process near middle; styles widest near base, more or less pediform, apices sharp. In caudoventral view, aedeagal brace broadly rounded; styles widest on basal half, constricted on outer third, then sharply rounded to narrowed apices.

Holotype ♂ and 3 ♂ paratypes, Thomasville, Ga., June 30, 1948, R. H. Beamer. Types in the Snow Entomological Collections.

3. **Bakerella pediforma** n. sp

Brachypterous form:

Resembling **Bakerella rotundifrons** Beamer but with the median carina of the clypeus divided almost at the apex. Length ♂ 1.8 mm.; ♀ 2 mm.

Structure: Clypeus about one-fifth longer than greatest width, widest near middle, narrowed toward each end, practically quadricarinate since the median carina divides almost at apex; crown about as long as basal width, widest at apex, carinae distinct; elytra about as broad as long, apices broadly rounded, veins raised with a few puncts on them; dorsum of abdomen with a few pustules on each side.

Color: General color stramineous or light brown; clypeus with color

between outer and inner carinae somewhat darker with four pairs of median light spots and three lateral pairs; elytra with a few dark spots surrounding the white lunate marks at apices; abdomen with a darker area on dorsum before genital capsule on each side.

Genitalia: In lateral view, pygofer of male more or less rectangular with a very long sharp, caudodorsally projecting spine on ventrocaudal corner; anal segment with a pair of very short, narrow, almost straight, processes; aedeagus widest at base, quite long, narrowed on dorsal margin near middle, outer half resembling a foot with the base on dorsal margin; aedeagal brace barely visible; styles widest at base, slightly spatulate at apices. In caudal view, aedeagal brace roundingly excavated; styles widest near basal third, slightly narrowed just before pediform apices.

Holotype ♂, allotype ♀, 1 ♂ and 6 ♀ paratypes, Slidell, La., March 3, 1947, R. H. Beamer; other paratypes: 1 ♂ and 2 ♀♀, Ocean Springs, Miss., March 3, 1947, R. H. Beamer; 1 ♀, Pearlington, Miss., March 3, 1947, R. H. Beamer; 1 ♂, Sanford, Fla., May 13, 1926, E. D. Ball.

Types and paratypes in Snow Entomological Collections; paratypes in E. D. Ball Collection, U.S.N.M.

4. **Bakerella minuta** n. sp.

Brachypterous form:

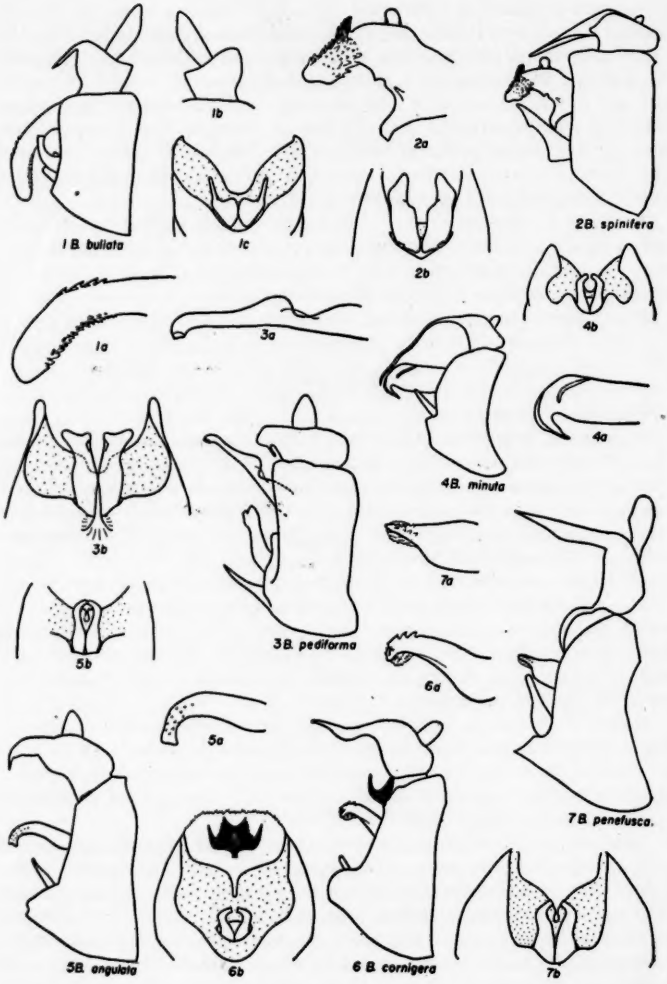
Resembling **Bakerella rotundifrons** Beamer but smaller, median frontal carina dividing near basal third instead of near middle with a pair of white spots at point of division, a second pair between these and base and usually two pairs near apex although apical pair is usually very small and sometimes wanting and male anal segment with a pair of very long, slender processes. Length ♂, 1.2 mm.; ♀, 1.6 mm.

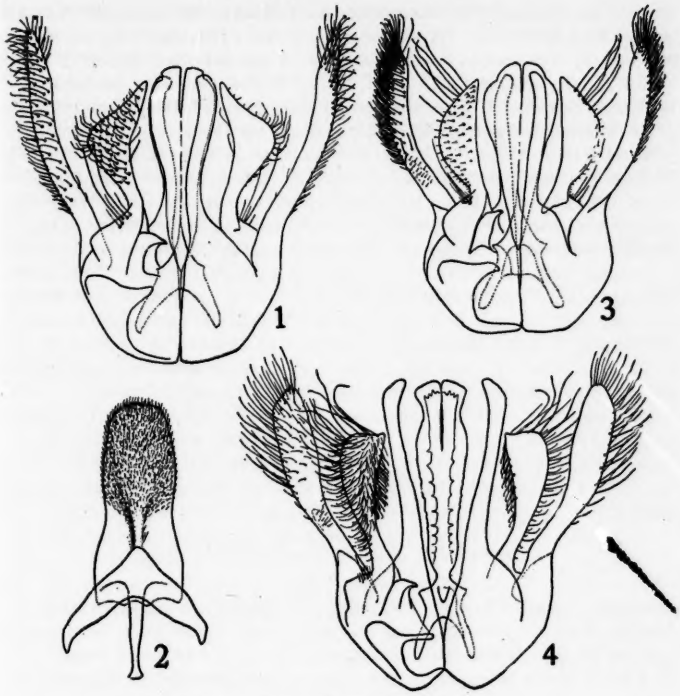
Structure: Front about one-third longer than wide, widest near middle, narrowed toward each end, about one-half as wide at apex as base, distinctly tricarinate, median carina divided just beyond middle toward base; crown longer than width at base, widest at apex, carinae distinct; elytra about as wide as long, narrowed on outer margin to rounded apices on inner third, veins raised with round puncts.

Color: Front brown with four pairs of light markings, two before division of median carina; black puncts and a diagonal black band across apices of elytra with two white spots on margin in this black band; dorsum of abdomen usually with two longitudinal rows of white pustules on each side and sometimes a median light line.

Genitalia: In lateral view, pygofer of male more or less half-moon shaped, with a deep notch just below middle in caudal margin; anal segment with a pair of very long filament-like processes, as long as width of pygofer; aedeagus on basal two-thirds half as wide as length of pygofer, sharply curved into half circle and narrowed to sharp point on apical third; styles widest at base, gradually narrowed to rounded apices, straight. In ventral view, aedeagal brace not produced dorsally; styles widest at base, narrowed to apices, incurved on outer fourth.

Holotype ♂, allotype ♀, 46 ♂ and 100 ♂ paratypes, Inglis, Fla., March 9, 1947, R. H. Beamer; other paratypes: 7 ♂♂ and 22 ♀♀, same place and time,


1 B. bullata
1b
1c
2a
2b
2B. spinifera
1a
3a
4b
4a
4B. minuta
3b
3B. pediforma
7a
5b
6a
7B. penefusca.
5a
5B. angulata
6b
6 B. cornigera
7b



EXPLANATION OF FIGURES

Figure 1. Male genitalia of **Anoplius (Pompilinus) grandiflexionis** n. sp. Figure 2: Male subgenital plate of **A. (P.) grandiflexionis** n. sp. Figure 3: Male genitalia of **A. (P.) percitus** n. sp. Figure 4: Male genitalia of **A. (P.) krombeini** n. sp. In the figures of the genitalia, the ventral aspect is shown on the left side, the dorsal on the right.

June [Carnegie Museum]. Essex Co. 1 ♀, Mt. McIntyre, 27 August 1940 (H. Dietrich) [Cornell U.]. New York City 1 ♀, Hunter's Island, 3 Sept. 1942 (R. Schuster) [Cornell U.]. Suffolk Co. 1 ♂, Babylon, 17 July 1937 (F. S. Blanton) [California Academy of Sciences]. Westchester Co. 1 ♂, Millwood, 21 June 1936 [Cornell U.]. "Long Island" 1 ♂ [U.S. National Museum]. MASSACHUSETTS: Hampshire Co. 2 ♀♀, 1 ♂, Amherst [U. Massachusetts]; 1 ♀, Cummington, 31 Aug. 1947, on flowers of **Solidago** (H. E. Evans) [Coll. author]. Middlesex Co. 1 ♀, Melrose Highlands, 10 Aug. 1915 (F. X. Williams) [California Academy of Sciences]. Suffolk Co. 1 ♀, Boston, 30 August 1914 (F. X. Williams) [Calif. Academy of Sciences]; 3 ♀♀, Forest Hills, 30 August 1914 (F. X. Williams) [Calif. Academy of Sciences]. CONNECTICUT: Hartford Co. 9 ♀♀, 1 ♂, East Hartford, on banks of Con-

necticut R., on flowers of **Daucus carota, Solidago, and Anaphalis margaritacea,** 13 June-20 Sept. (H. E. Evans) [Coll. author, Academy of Natural Sciences of Philadelphia, and Museum of Comparative Zoology]. NEW JERSEY: Burlington Co. 1 ♀, 3 ♂♂, Riverton, 14 July-29 Sept. [U.S. National Museum]; 1 ♀, Bridgeboro, 8 Sept. 1926 (H. W. Allen) [U.S. National Museum]. PENNSYLVANIA: Allegheny Co. 1 ♀, Pittsburgh, July [Carnegie Museum]; 1 ♀, Sample Station, 22 Aug. 1909 (H. Kahl) [Carnegie Museum]; 1 ♀, Braddock, 17 Aug. 933 (H. A. Scullen) [Oregon State College]. Dauphin Co. 1 ♀, Highspire, 4 Sept. 1909 (W. S. Fisher) [U.S. National Museum]. Philadelphia 1 ♀ Lawndale, 15 Sept. 1901 [Academy of Natural Sciences of Philadelphia]. MARYLAND: Montgomery Co. 4 ♀♀, 1 ♂, Glen Echo, Summer 1917 & July 1927 (R. M. Fouts) [U.S. National Museum]. DISTRICT OF COLUMBIA: 12 ♀♀, 9 ♂♂, Washington, 30 June-14 Sept. (M. S. Vogel & R. Boettcher) [Coll. M. S. Vogel and of author]. VIRGINIA: 1 ♂ (no further data) [Univ. Minnesota]. Fairfax Co. 1 ♂, Falls Church, 30 Aug. (N. Banks) [Museum of Comparative Zoology]; 1 ♀, E. Falls Church, 24 Sept. (S. A. Rohwer) [U.S. National Museum]; 1 ♀, Dunn Loring, 30 Aug. 1947 (K. V. Krombein [Coll. K. V. Krombein]; 1 ♀, Clifton, 30 June 1935 (K. V. Krombein) [Coll. K. V. Krombein]. ALABAMA: 1 ♀, Tuscaloosa, 4 Oct. 1947 (R. L. Chermock) [Coll. author]. TEXAS: Brazos Co. 1 ♀, 1 ♂, 10 Oct. 1938, on goldenrod (J. E. Gillaspy) [Coll. J. E. Gillaspy].

Anoplius (Pompilinus) krombeini n. sp[3]

(Fig. 4)

Male: Length 6.2 mm.; fore wing 4.7 mm. Color black; wings nearly hyaline, with a brownish outer marginal band. Pubescence brownish, becoming silvery on the scape below, the clypeus, lower front, temples, front and sides of the pronotum, coxae, pleura, and propodeum. Clypeus, front, and vertex with a very few short setae; abdominal sternite four with a brush of suberect setae of moderate length (longer than in **percitus** or **subcylindricus,**) and sternite five and the subgenital plate with shorter, suberect setulae.

Clypeus a little over twice as broad as high, its apical margin slightly arcuately concave. Front rather narrow; inner orbits diverging very slightly above. Ocelli forming a right triangle, the ocello-ocular and post-ocellar distances about equal. Antennae very slender, the first four segments in a ratio of about 3:1:3:3, the third segment three times as long as thick.

Posterior margin of pronotum distinctly angulate. Postnotum medially nearly as long as the metanotum. Propodeum with a weakly impressed median line, its slope very low, only slightly steepened behind. Marginal cell of fore wing nearly twice its own length from the apex of the wing; third submarginal cell petiolate.

Subgenital plate of moderate breadth, the median line distinctly ele-

[3] Named for Mr. Karl V. Krombein, of the Division of Insects, U.S. National Museum, who collected the type and a long series of paratypes of this species near Nags Head, N.C. in the summer of 1948.

between outer and inner carinae somewhat darker with four pairs of median light spots and three lateral pairs; elytra with a few dark spots surrounding the white lunate marks at apices; abdomen with a darker area on dorsum before genital capsule on each side.

Genitalia: In lateral view, pygofer of male more or less rectangular with a very long sharp, caudodorsally projecting spine on ventrocaudal corner; anal segment with a pair of very short, narrow, almost straight, processes; aedeagus widest at base, quite long, narrowed on dorsal margin near middle, outer half resembling a foot with the base on dorsal margin; aedeagal brace barely visible; styles widest at base, slightly spatulate at apices. In caudal view, aedeagal brace roundingly excavated; styles widest near basal third, slightly narrowed just before pediform apices.

Holotype ♂, allotype ♀, 1 ♂ and 6 ♀ paratypes, Slidell, La., March 3, 1947, R. H. Beamer; other paratypes: 1 ♂ and 2 ♀♀, Ocean Springs, Miss., March 3, 1947, R. H. Beamer; 1 ♀, Pearlington, Miss., March 3, 1947, R. H. Beamer; 1 ♂, Sanford, Fla., May 13, 1926, E. D. Ball.

Types and paratypes in Snow Entomological Collections; paratypes in E. D. Ball Collection, U.S.N.M.

4. **Bakerella minuta** n. sp.

Brachypterous form:

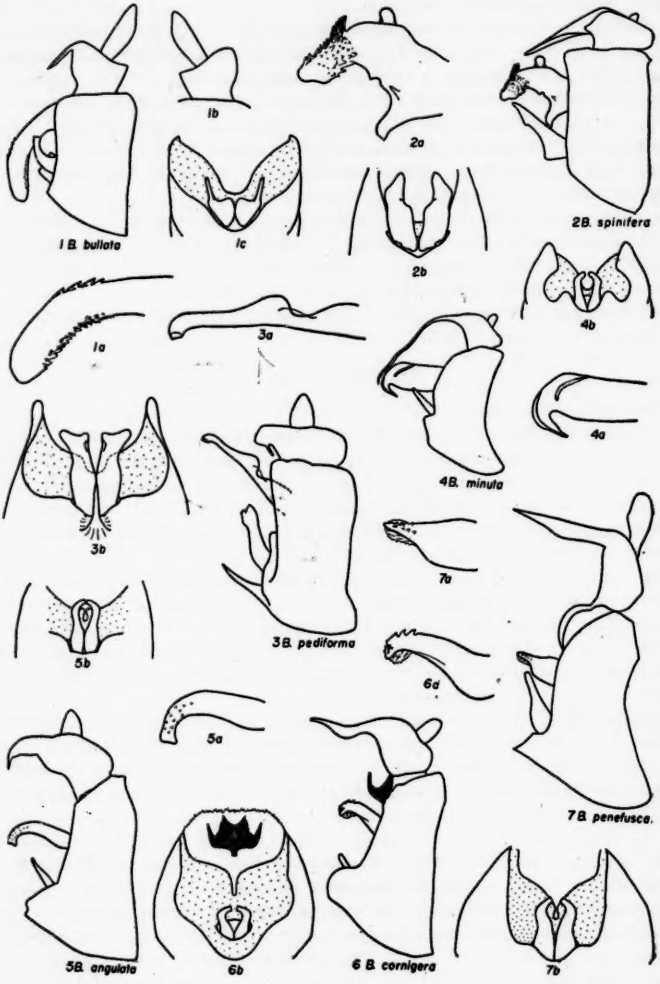
Resembling **Bakerella rotundifrons** Beamer but smaller, median frontal carina dividing near basal third instead of near middle with a pair of white spots at point of division, a second pair between these and base and usually two pairs near apex although apical pair is usually very small and sometimes wanting and male anal segment with a pair of very long, slender processes. Length ♂, 1.2 mm.; ♀, 1.6 mm.

Structure: Front about one-third longer than wide, widest near middle, narrowed toward each end, about one-half as wide at apex as base, distinctly tricarinate, median carina divided just beyond middle toward base; crown longer than width at base, widest at apex, carinae distinct; elytra about as wide as long, narrowed on outer margin to rounded apices on inner third, veins raised with round puncts.

Color: Front brown with four pairs of light markings, two before division of median carina; black puncts and a diagonal black band across apices of elytra with two white spots on margin in this black band; dorsum of abdomen usually with two longitudinal rows of white pustules on each side and sometimes a median light line.

Genitalia: In lateral view, pygofer of male more or less half-moon shaped, with a deep notch just below middle in caudal margin; anal segment with a pair of very long filament-like processes, as long as width of pygofer; aedeagus on basal two-thirds half as wide as length of pygofer, sharply curved into half circle and narrowed to sharp point on apical third; styles widest at base, gradually narrowed to rounded apices, straight. In ventral view, aedeagal brace not produced dorsally; styles widest at base, narrowed to apices, incurved on outer fourth.

Holotype ♂, allotype ♀, 46 ♂ and 100 ♂ paratypes, Inglis, Fla., March 9, 1947, R. H. Beamer; other paratypes: 7 ♂♂ and 22 ♀♀, same place and time,


1 B. bullata
1b
1c
2a
2b
2B. spinifera
1a
3a
4b
4a
4B. minuta
3b
3B. pediforma
7a
5b
6a
7B. penefusca.
5a
5B. angulata
6b
6 B. cornigera
7b

L. D. Beamer; 12 ♂♂ and 12 ♀♀, Zolfo Springs, Fla., March 12, 1947, R. H. Beamer; 4 ♂♂ and 4 ♀♀, Gainesville, Fla., July 6, 1948, R. H. Beamer; 5 ♂♂ and 1 ♀, Lacoochee, Fla., July 7, 1948, R. H. Beamer; 12 ♂♂ and 7 ♀♀, Lake Placid, Fla., July 13, 1948, R. H. Beamer; 2 ♂♂ and 2 ♀♀, Waycross, Ga., March 18, 1947, R. H. Beamer; 1 ♂, Okefenokee Swamp, Ga., July 30, 1948, R. H. Beamer; 3 ♂♂, Okeechobee, Fla., March 17, 1947, R. H. Beamer; 6 ♀♀, Sanford, Fla., March 27, 1926, E. D. Ball; 1 pair, Sebring, Fla., Aug. 24, 1926, E. D. Ball.

Types and paratypes in Snow Entomological Collection; paratypes in the E. D. Ball Collection, U.S.N.M.

Macropterous form:

Like the brachypterous form but with flight wings about one-third their length longer than abdomen. Less marked with dark than most species. Veins with dark puncts evenly scattered over their length, with a dark spot on tip of clavus and with the normal V-shaped darker area on costal margin on outer third often broken into spots.

Holomorphotype ♀ and 27 ♀ paramorphotypes, Lake Placid, Fla., July 13, 1948, R. H. Beamer.

Types in the Snow Entomological Collections.

5. **Bakerella angulata** n. sp.

Brachypterous form:

Resembling **B. rotundifrons** Beamer but aedeagus in lateral view bent ventrally at right angle on outer third. Length ♂, 1.4 mm.; ♀ 1.7 mm.

Structure: Clypeus about one fourth longer than wide at widest place, widest near basal third, narrowed toward each end, more so at apex, definitely tricarinate, median carina divided near widest place in clypeus; crown about one fourth longer than width at base, widest at apex, definitely carinate; elytra about as long as wide, rounded on apices, veins slightly raised with a more or less even pattern of brown puncts.

EXPLANATION OF PLATE

1. **Bakerella bullata** n. sp., lateral view of right side of male genital capsule; 1a, lateral view of aedeagus enlarged; 1b, left side of anal segment without a process; 1c, caudoventral view of male genital capsule with styles and aedeagal brace.
2. **Bakerella spinifera** n. sp. lateral view of right side of male genital capsule; 2a, lateral view of aedeagus enlarged; 2b, caudoventral view of male genital capsule with styles and aedeagal brace.
3. **Bakerella pediforma** n. sp., lateral view of right side of male genital capsule; 3a, lateral view of aedeagus enlarged; 3b, caudoventral view of male genital capsule with styles and aedeagal brace.
4. **Bakerella minuta** n. sp., lateral view of right side of male genital capsule; 4a, lateral view of aedeagus enlarged; 4b, caudoventral view of male genital capsule with styles and aedeagal brace.
5. **Bakerella angulata** n. sp., lateral view of right side of male genital capsule; 5a, lateral view of aedeagus enlarged; 5b, caudoventral view of male genital capsule with styles, and aedeagal brace.
6. **Bakerella cornigera** n. sp., lateral view of right side of male genital capsule; 6a, lateral view of aedeagus enlarged; 6b, caudoventral view of male genital capsule with styles, aedeagal brace, and pair of black horns on connective.
7. **Bakerella penefusca** n. sp., lateral view of right side of male genital capsule; 7a, lateral view of aedeagus enlarged; 7b, caudoventral view of male genital capsule with styles, and aedeagal brace.

Color: General color varies from buff to dark brown; clypeus dark on apical third, remainder quite light, usually four pairs of median and three pairs of lateral light spots, two pairs of median light spots far before division of median carina; elytra with puncts dark and more or less apical dark band on outer half except apical pair of semicircular white spots; abdomen mottled.

Genitalia: In lateral view, pygofer of male almost triangular, widest on venter; anal segment with a pair of heavy processes curving ventrally; aedeagus widest at base, slightly narrowing throughout, curving ventrally almost at right angles on outer third, apex truncate, outer third sparsely set with short retrorse teeth; styles widest at base, gradually narrowing to sharp apices. In caudoventral view, aedeagal brace narrowly excavated; styles widest on basal third, narrowing to rounded apices, turned in on apical fifth.

Holotype ♂, allotype ♀, and 11 ♂ and 6 ♀ paratypes, Yankeetown, Fla., March 9, 1947, R. H. Beamer; other paratypes: 1 ♂, same place and collector, July 7, 1948; 3 ♂ ♂ and 1 ♀, Yankeetown, Fla., March 9, 1947, L. D. Beamer; 1 ♂, Sanford, Fla., March 11, 1947, R. H. Beamer; 1 ♂, La Belle, Fla., July 19, 1948, R. H. Beamer; 1 ♂, Inglis, Fla., March 9, 1947, L. D. Beamer; 3 ♂ ♂ and 2 ♀ ♀, Melbourne, Fla., March 17, 1947, R. H. Beamer.

Types in Snow Entomological Collections.

6. **Bakerella cornigera** n. sp.

Brachypterous form:

Closely related to **Bakerella cinerea** Beamer but usually with the median row of light spots on clypeus joined with the light median carina and the male genitalia with a pair of horn-like processes just below the processes on the anal segment. Length ♂, 1.8 mm.; ♀, 2 mm.

Structure: Clypeus slightly more than one-third longer than greatest width, widest near apical third, narrowed toward each end, more so toward apex, strongly tricarinate, median carina dividing near basal third; crown slightly longer than wide, widest at apex, carinae distinct; elytra about as wide as long, apex broadly rounded, almost parallel with side of scutellum, veins raised with a more or less even pattern of brown puncts; dorsum of abdomen with several raised pustules on each side.

Color: General color brown, mottled with lighter; clypeus almost black with five pairs of light, usually connected, median spots and four pairs of lateral spots on basal two-thirds; crown light with fovea darker; membrane of elytra semihyaline except large dark spot near apices and two lunate white spots on apical margins; pustules and median carina of abdomen usually quite light.

Genitalia: In lateral view, pygofer of male about one-fourth longer on ventral margin than on dorsal, sharply narrowed on ventral fourth; anal segment with a pair of sinuate processes as long as width of segment and another pair of black, diverging, curved processes caudally connecting the segment to the pygofer; aedeagus about twice as wide at base as just before apex, apex slightly enlarged with three short, retrorse teeth on dorsal margin; styles just visible as short, narrow, straight-sided shafts with

rounded apices. In caudoventral view, processes connecting pygofer to anal segment evident as very heavy, sharp, diverging, black processes; aedeagal brace narrowly and deeply excavated; styles widest at base, narrowing to incurved, truncated apices.

Holotype ♂, allotype ♀, and 1 ♂ paratype, Ashland, Pa., August 21, 1946, R. H. Beamer; other paratypes: 3 ♂♂, Cameron, Pa., August 21, 1946, R. H. Beamer; 1 ♂, Woodbridge, Va., August 28, 1946, R. H. Beamer.

Types in the Snow Entomological Collections.

7. **Bakerella penefusca** n. sp.

Brachypterous form:

Resembling **Bakerella fusca** Beamer but with five pairs of median light spots on the clypeus instead of three and aedeagus of male narrowed on ventral side instead of dorsal. Length ♂, 1.6 mm.; ♀, 2.1 mm.

Structure: Clypeus a little more than one-third longer than wide, widest near middle, narrowed toward each end, more so toward apex, strongly tricarinate, median carina divided near basal third; crown about as long as basal width, widest at apex, carinae distinct; elytra longer than wide, apices broadly rounded, more or less parallel with sides of scutellum, veins raised with usual dark puncts; dorsum of abdomen with a few pustules along sides.

Color: General color varies from light to quite dark; clypeus usually quite dark with three lateral pairs of light spots basad of middle and five median pairs, the apical ones very small and the two basal ones joining the carinae; elytra varying from almost entirely buff to about the outer third almost black, two white lunate apical spots on each elytra.

Genitalia: In lateral view, pygofer of male almost triangular, posterioventral corner extended wedge-shaped; anal segment with a pair of long, almost straight, processes with very sharp apices; aedeagus more than twice as wide at base as apex, sharply narrowed on ventral margin, near outer third to more or less rounded apex, with number of short sharp teeth on narrowed portion; styles widest at base, almost straight, suddenly narrowed near basal third to about one-fourth basal width, apices rounded. In caudoventral view, aedeagal brace narrowly and strongly excavated; styles widest at bases, sinuate and gradually narrowed to truncate apices.

Holotype ♂ and 10 ♂ paratypes, Canaan, N.H., August 11, 1946, R. H. Beamer; allotype ♀, and 11 ♀ and 15 ♂ paratypes, Storrs, Conn., August, 1946, R. H. Beamer; other paratypes: 1 ♂ and 1 ♀, Durham, N.H., August 12, 1946, R. H. Beamer; 1 ♂ and 1 ♀, Peck's Pond, Pa., August 20, 1946, R. H. Beamer.

Macropterous form:

Like the brachypterous form but with flight wings which extend about half their length beyond the abdomen.

Holomorphotype ♂, allomorphotype ♀ and 1 ♂ paramorphotype, Storrs, Conn., August, 1946, R. H. Beamer.

Types in Snow Entomological Collections.

MUTUAL RELATIONSHIPS BETWEEN LEAFHOPPERS AND ANTS

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Probably because the majority of leafhoppers (Homoptera, Cicadellidae) shoot their excreta or honeydew into the air so that it drops free of the leaf or stem surfaces upon which they rest, these insects are not often tended by ants. Most leafhoppers are active, and even in the nymphal stage will attempt to escape a disturbance by running around a stem or to the opposite side of a leaf. The adults of most species jump or fly readily.

Those groups of Homoptera which are commonly tended by ants (e.g. Aphididae, Coccidae, Membracidae) are in general less active than are the Cicadellidae and at least in the presence of tending ants liberate their honeydew slowly so that it can be lapped up by the ants. This general correlation between adaptability to tending ants and ability to move rapidly and escape enemies may not be accidental. In other words, the lethargic habits of certain groups may have been made possible by the protection supposedly offered by tending ants. Such protection being available only to those forms which liberate their honeydew slowly, it would be natural to find the sluggish short winged or wingless forms among such groups. Presumably sluggish forms originating among groups whose honeydew is not readily available to ants would often be unsuccessful because of the activities of predators and parasites.

Among the important questions which must be answered if the validity of these arguments is to be tested is, do ants tending Homoptera actually provide protection for the Homoptera or is the relationship entirely in favor of the ants which obtain food in the form of honeydew? Ants do construct sheds for aphids, they are active in dispersing some Homoptera, and they can often be observed to rear up and attack or chase away enemies wandering among aphids. Therefore the answer to the question seems to be that both ants and Homoptera profit by their association in the case of the more highly specialized examples of mutual relationships. Presumably less specialized and incipient mutual relations are also mutually advantageous in lesser degrees.

The evidence presented below seems to indicate that mutual relationships develop very rapidly from the evolutionary viewpoint. Any source of sweets is quickly exploited by many ants; this therefore requires no time-consuming adaptations. The principal adaptations necessary are in the honeydew producers, which must exude the honeydew slowly so that it can be lapped up by the ant, and above all must not hop away at the approach of an ant.

The rather large, robust leafhoppers of the genus **Parabolocratus** are apparently all found on various grasses. Certain species, such as the common **P. viridis** (Uhler), are relatively agile, will hop when disturbed, and therefore can be easily swept with a net from the grasses on which they live. Such a species, as yet unidentified, was found in the vicinity where **P. curtus** was studied, and was never observed to be tended by ants.

EXPLANATION OF FIGURE

Figure 1. Portion of stem and leaf base of the grass, **Panicum virgatum**, showing a female leafhopper (**Parabolocratus curtus** Shaw) and the ants (**Formica bradleyi** Wheeler) tending her. One of the ants is shown lapping up a droplet of honeydew from anal opening of the leafhopper.

By contrast **Parabolocratus hepneri** Beamer, 1948, and **P. curtus** Shaw, 1932, are sluggish and except for the adult males can rarely be induced to hop. These species, wherever we found them, were tended by the ant, **Formica bradleyi** Wheeler (identified by M. R. Smith). Not a single individual of either of these leafhoppers was ever found by us without one or more ants around it[1] and often several ants would be observed soliciting honeydew from a single leafhopper. We suspect that the ants are important in the survival of these robust, sluggish leafhoppers, not only because they are always associated with the leafhoppers but because, if the leafhoppers were

[1]Except for a few swept from the grass which may not have been tended by ants.

disturbed with a straw, the nearby ants would quickly open their jaws and seize the straw. Probably they protect the relatively helpless leafhoppers from their natural enemies.

Parabolocratus hepneri was originally found, tended by **Formica bradleyi**, among the sand hills south of Garden City, Kansas. The host plant of the leafhoppers is the grass, **Calamivilfa longifolia**. We revisited this spot on June 15, 1949, and found the grass nearly absent in the locality, possibly because of grazing, and the leafhopper apparently entirely wanting. Two days later, in the sand hills south of Syracuse, Kansas, we found the grass and the leafhopper in abundance. Adult females were more numerous than males and were laying eggs, but no nymphs were present. Our observations were brief but evidently the position of the leafhoppers on the grass and their relationship to the ants were essentially identical to those described below for **Parabolocratus curtus**.

Parabolocratus curtus, previously known from one specimen from Riley County and another from Ellsworth County, Kansas, has been collected by us in a group of sand hills lying a short distance north of Hutchinson and west of Medora, Kansas. It was first found there on June 19, 1949, at which time numerous small nymphs and some adult females were present. Apparently all males of the first generation had died. Beamer revisited the locality on July 2 and found only a few large nymphs. On July 15 Michener found about half of the population were still large nymphs of the second generation but many males had matured as well as a few females. No eggs nor small nymphs were present. On September 6 we found one nymph and a few adults, perhaps of a third generation.

The grass on which this leafhopper feeds is **Panicum virgatum**. Although this is a widespread grass, **P. curtus** was found on it only in a small area, perhaps 200 feet long. The grass has erect stems with rather broad leaves extending outward. The leafhoppers, without exception, were found on the upper surfaces of the leaves near their bases. Although small nymphs may be oriented in any position, half grown and larger nymphs and adults face the stem (Figure 1), one to three or four per leaf base.

Day and night the leafhoppers were tended by the ants (**Formica bradleyi**). The small nymphs sometimes greatly exceed in number the tending ants, but leafhoppers more than half grown were generally less numerous than the ants. Sometimes a single leafhopper on a leaf would be surrounded by four or five ants.

Although **Formica bradleyi** is an agile ant, those on the grass near a leafhopper usually move about slowly, tapping all parts of the leafhopper with the antennae. Sometimes two or more ants tap a leafhopper at the same time. Although the ants often step on the leafhopper, this attention from the ants has no visible effect. It is possible that the tapping influences the frequency or manner of honeydew excretion. Small nymphs, however, each of which was observed on July 19 to receive little attention from the ants, because of the number of nymphs and the presence of more remunerative adult females, nonetheless excreted honeydew in the same manner as older individuals well tended by ants.

A drop of clear liquid honeydew is excreted by each leafhopper about once per minute. As soon as the drop begins to rise from the anal opening an ant is there to lap it up. Ordinarily the ant whose head happens to be closest to the posterior part of the leafhopper is the one which gets the honeydew. The ants, however, show no tendency to remain close to the posterior part of a leafhopper but wander slowly about, tapping any part that they can reach. Several droplets of honeydew are evidently necessary to fill the crop of an ant. Sometimes an ant is seen to take a drop, and then quickly leave the other ants and run down the grass stem and toward the nest. Such ants have apparently received one or more droplets beforehand.

Formica bradleyi is an ant known from Alberta to Kansas, and is definitely an ammophilous species living in sandy areas where the vegetation is scanty (see G. C. and E. W. Wheeler, 1944, North Dakota Hist. Quart., 11:258). The ant appears to be a general gatherer of honeydew, for we have seen it tending aphids and membracid nymphs near Syracuse and scale insects (Coccidae) near Hutchinson. The scale insects (**Phenacoccus dearnessi** King, determined by Harold Morrison) were on the bases of small wild plum (**Prunus angustifolia**) bushes growing among the sand hills, and the grass bearing leafhoppers often grew up through these plum bushes. The same grass, growing by itself, was rarely infested with **Parabolocratus.**

SOME LOCALITY RECORDS OF UTAH HELEIDAE

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The writers are indebted to Willis W. Wirth for supplying the following records of biting midges, obtained from material submitted to the National Museum since 1933 by personnel of the Utah State Agricultural College.

Leptoconops kerteszi Kieffer. Often extremely annoying and abundant. At Black Rock, Great Salt Lake, April 7, 1934 (G. F. Knowlton); Blue Creek, April 19, 1934 (Knowlton-J. A. Rowe); Deseret, June 17, 1948 (Knowlton-S. L. Wood-D. M. Allred); Dolomite, April 17, 1934 (Knowlton-W. L. Thomas); Flux, May 19, 1933 (Knowlton); Grantsville, April 17, 1934 (Knowlton-Thomas); Indian Creek, May 11, 1949 (Knowlton-H. F. Thornley); Kanosh, May 24, 1938 (Knowlton); Lakepoint, May 5, 1948 (Knowlton); Locomotive Springs, April 24, 1934 (Knowlton-Rowe); Nephi, May 12, 1948 (Knowlton); Nephi Meadows, April 21, 1949 (Knowlton-Thornley); north of Genola, (Knowlton-H. E. Dorst); Penrose, April 14, 1934 (Knowlton-Rowe); Skull Valley, April 17, 1934 (Knowlton-Thomas); Timpie, April 17, 1934 (Knowlton-Thomas).

Culicoides varüpennis (Coq.). Extremely numerous and annoying to man at Delta, April 25, 1949 (Knowlton-G. E. Bohart-W. P. Nye); Moab, June

8, 1948 (Knowlton-F. C. Harmston-Wood); Nephi Meadows, April 21, 1949 (Knowlton-Thornley).

C. luteovenus Root & Hoffman. At Vernal, June 23, 1948 (Knowlton).

C. palmerae James. Vernal, June 23, 1948 (Knowlton).

C. cockerellii (Coq.). Kanab, July 14, 1948 (Knowlton); Logan, June 11, 1948 (Knowlton); Myton, August 23, 1948 (Knowlton); Vernal, June 24, 1948 (Knowlton).

C. crepuscularis Malloch. Hyrum, May 20, 1948 (Knowlton); Logan, July 19, 1948 (Knowlton-Wood); Panguitch, July 14, 1948 (Knowlton-Wood).

C. haematopotus Malloch. Moab, June 8, 1948 (Knowlton-Harmston-Wood).

C. stellifer (Coq.). Logan, June 11, 1948 (Knowlton).

C. utahensis Fox. Ephraim, June 12, 1943 (Knowlton-Telford), in ear of Jackrabbit.

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